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THESIS

A CAPABILITIES BASED ASSESSMENT OF THE UNITED STATES AIR FORCE CRITICAL CARE AIR TRANSPORT TEAM

by

Dennielle M. Matsumoto

September 2013

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13. ABSTRACT (maximum 200 words)

The United States Air Force Critical Care Air Transport (CCAT) mission is an American military tradition that has saved thousands of lives by providing airborne medical care to the critically ill and wounded. This life-saving mission is executed by CCAT teams, which usually consist of a critical care physician, critical care nurse, and respiratory therapist. A Front-end Analysis has found several problems within the CCAT system, justifying a need for further examination. Members from the 711th Human Performance Wing Human System Integration Directorate, Survivability Vulnerability Information Analysis Center, and the Naval Postgraduate School, formed an analysis team to conduct a Capabilities Based Assessment (CBA) on the CCAT system using a Human Systems Integration (HSI) perspective. The CBA identifies current and future capability gaps in the CCAT system, and provides prioritized HSI domain and Doctrine, Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy (DOTmLPF-P) recommendations that will close those gaps. This thesis documents how the analysis team applied HSI principles throughout the CBA process. It demonstrates the importance of the human perspective and examines how specific HSI Tools, Techniques, Approaches, and Methods (TTAMs) can be used in the early stages of the Department of Defense acquisition process.

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A CAPABILITIES BASED ASSESSMENT OF THE UNITED STATES AIR FORCE CRITICAL CARE AIR TRANSPORT TEAM

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ABSTRACT

The United States Air Force Critical Care Air Transport (CCAT) mission is an American military tradition that has saved thousands of lives by providing airborne medical care to the critically ill and wounded. This life-saving mission is executed by CCAT teams, which usually consist of a critical care physician, critical care nurse, and respiratory therapist. A Front-end Analysis has found several problems within the CCAT system, justifying a need for further examination. Members from the 711th Human Performance Wing Human System Integration Directorate, Survivability Vulnerability Information Analysis Center, and the Naval Postgraduate School, formed an analysis team to conduct a Capabilities Based Assessment (CBA) on the CCAT system using a Human Systems Integration (HSI) perspective. The CBA identifies current and future capability gaps in the CCAT system, and provides prioritized HSI domain and Doctrine, Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy (DOTmLPF-P) recommendations that will close those gaps. This thesis documents how the analysis team applied HSI principles throughout the CBA process. It demonstrates the importance of the human perspective and examines how specific HSI Tools, Techniques, Approaches, and Methods (TTAMs) can be used in the early stages of the Department of Defense acquisition process.

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LIST OF ACRONYMS AND ABBREVIATIONS

AE	Aeromedical Evacuation
AECM	Aeromedical Evacuation Crew Member
AFHSIO	Air Force Human Systems Integration Office
AFRC	Air Force Reserve Command
AMC	Air Mobility Command
ANG	Air National Guard
AOI	areas of interest
CASEVAC	casualty evacuation
CBA	Capabilities Based Assessment
CCAT	Critical Care Air Transport
C-STARS	Centers for Sustainment of Trauma and Readiness Skills
CVC	Clinical Validation Committee
DCR	DOTmLPF-P Change Recommendation
DOTmLPF-P	Doctrine, Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy
DoD	Department of Defense
DPS	Defense Planning Scenarios
EAES	Expeditionary Aeromedical Evacuation Squadron
FEA	Front-end Analysis
FHP	Force Health Protection
HFE	Human Factors Engineering
HPW/HP	Human Performance Wing Human System Integration Directorate
HPW/RH	Human Effectiveness Directorate
HSI	Human Systems Integration
HTA	hierarchical task analysis
ICD	Initial Capabilities Document
ICU	Intensive Care Unit
IHMC	Institute of Human and Machine Cognition
ILCM	Integrated Life Cycle Management Process
JCIDS	Joint Capabilities Integration and Development System

JERCCS	Joint En Route Casualty Care System
JROC	Joint Requirements Oversight Council
MCD	Medical Crew Director
MEDEVAC	medical evacuation
MPR	monthly progress review
MTF	medical treatment facility
NPS	Naval Postgraduate School
OSF	Operational Support Flier
PMR	patient movement request
PMRC	Patient Movement Requirement Center
PTSD	Post-Traumatic Stress Disorder
ROD	record of decisions
SME	subject matter experts
SURVIAC	Survivability Vulnerability Information Analysis Center
TACC	Tanker/Airlift Control Center
TCCET	Tactical Critical Care Evacuation Teams
TTAMs	Tools, Techniques, Approaches, and Methods
TIM	Technical Interchange Meeting
USAF	United States Air Force
USAFSAM	United States Air Force School of Aerospace Medicine
USTRANSCOM	United States Transportation Command
WPAFB	Wright-Patterson Air Force Base

EXECUTIVE SUMMARY

The United States Air Force (USAF) Critical Care Air Transport (CCAT) mission is an American military tradition that has saved thousands of lives by providing airborne medical care to the critically ill and wounded. This life-saving mission is executed by CCAT teams, which usually consist of a critical care physician, critical care nurse, and respiratory therapist.

A Front-end Analysis from 2012 found several problems within the CCAT system, justifying further examination of the CCAT system. Members from the 711th Human Performance Wing Human System Integration Directorate, Survivability Vulnerability Information Analysis Center, and the Naval Postgraduate School formed an analysis team to conduct a Capabilities Based Assessment (CBA) on the CCAT system using a Human Systems Integration (HSI) perspective.

The analysis team conducted a year-long, five-phased HSI-focused CBA. During Phase 1 of the CBA process, the analysis team determined the scope of the CCAT CBA and wrote the study problem statement. In Phases 2 and 3, the analysis team created scenarios and conducted a hierarchical task analysis, which were tools used to solicit subjective data from subject matter experts during two technical interchange meetings. Upon the conclusion of Phase 3, the analysis team identified eight capabilities, 35 functions, and 183 tasks comprising the CCAT mission. Phase 4 of the project consisted of a risk assessment to determine and prioritize the 41 highest risk task-level gaps. During Phase 5, the analysis team created a recommendation matrix which was used to organize the Doctrine, Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy (DOTmLPF-P) and USAF HSI domain solutions. The analysis team developed 195 specific task-level recommendations, and provided the sponsors with 14 high-level recommendations.

This thesis documents how the analysis team applied HSI principles throughout the CBA process. It demonstrates the importance of the human perspective and examines how specific HSI Tools, Techniques, Approaches, and Methods can be used in the early

stages of the Department of Defense acquisition process. HSI practitioners can reference this thesis and use it to guide their own CBA efforts. Additionally, portions of this thesis were used to generate the CCAT CBA final report, which was delivered to the sponsors on September 30, 2013.

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I would like to thank the men and women of CCAT, especially those who took time out of their busy schedule to help with the CBA. I am truly inspired by each CCAT member's dedication to duty.

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I. INTRODUCTION

The United States Air Force (USAF) Critical Care Air Transport (CCAT) mission is an American military tradition that has saved thousands of lives by providing airborne medical care to the critically ill and wounded. This life-saving mission is executed by CCAT teams, which usually consist of a critical care physician, critical care nurse, and respiratory therapist. Despite the adverse working conditions of the airborne environment, CCAT teams are able to provide a patient with the same level of medical care that he or she would normally receive if treated at a ground-based hospital. Although the CCAT mission is highly successful, the manner in which the system currently operates is impacting CCAT members' safety, health, and performance. In order to prevent costly and unsafe long-term consequences, these human-centric issues can no longer be alleviated using reactionary measures, but must be proactively resolved to ensure the system is able to cope with new demands that will inevitably arise in future conflicts.

Several studies have investigated individual components and specific problems areas within CCAT; however, there has not been an assessment of the CCAT system as a whole. As a result, the 711th Human Performance Wing Human System Integration Directorate (HPW/HP) was tasked to conduct a Capabilities Based Assessment (CBA) on the CCAT system.

CBAs are typically conducted from an engineering perspective, focusing more on the technological aspects of a system and generally recommending materiel solutions. Unfortunately, this engineering "lens" often pays little to no attention to the human aspects of the system (L. Shattuck, personal communication, June 18, 2013). In order to gather a more comprehensive view of the system, the analysis team focused on the human element of the CCAT system by using a Human Systems Integration (HSI) "lens." This approach considers how the human-system interaction is affected by the nine USAF HSI domains, which include Manpower, Personnel, Training, Human Factors Engineering (HFE), Safety, Occupational Health, Environment, Habitability, and Survivability. This perspective not only improves total system performance, it strives to find non-materiel solutions in the form of HSI domains and Doctrine,

Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy (DOTmLPF-P) changes, which are normally more affordable and potentially faster to implement than materiel solutions.

A. OBJECTIVE

This study seeks to ensure the CCAT capability remains resilient to future changes in national strategy, policies, technology, weaponry, operating environment, and enemy tactics by identifying capability gaps and recommending both materiel and non-materiel solutions to fill those gaps. Additionally, the findings strive to improve and optimize the system so that CCAT members are able to perform their duties more safely, effectively, and efficiently in the future. This thesis documents how the analysis team applied HSI throughout the CBA process. It demonstrates the importance of the human perspective and examines how specific HSI Tools, Techniques, Approaches, and Methods (TTAMs) can be used in the early stages of the Department of Defense (DoD) acquisition process. HSI practitioners can reference this thesis and use it to guide their own CBA efforts. Additionally, portions of this thesis were used to generate the CCAT CBA final report, which was delivered to the sponsors on September 30, 2013.

B. PROBLEM STATEMENT

In July 2012, Booze Allen Hamilton's Survivability Vulnerability Information Analysis Center (SURVIAC) conducted a Front-end Analysis (FEA) on the USAF Aeromedical Evacuation (AE) and CCAT systems. Despite the 99.3% patient survival rate reported by the AE/CCAT FEA participants, SURVIAC identified weaknesses within both systems and categorized these into 164 areas of interest (AOI) (Graddy, Cooks, & Cosing, 2012). Approximately 30% of the AOI related specifically to CCAT, justifying the need for further examination of this system.

In September 2012, the analysis team, consisting of members from the 711th HPW/HP, SURVIAC, and the Naval Postgraduate School (NPS) was formed. 711th HPW/HP tasked the team to conduct a CBA on the CCAT system using an HSI perspective. The information gathered during the AE/CCAT FEA process was used as inputs into the CBA process and provided a starting point for the analysis team. The

AE/CCAT FEA found many challenges within the CCAT system. The goal of the current CBA effort was to identify current and future capability gaps in the CCAT system, provide prioritized DOTmLPF-P recommendations that will close those gaps, optimize system performance, and minimize cost and risk.

C. APPROACH

One important question the CBA addresses is whether the CCAT system is able to handle future changes. To properly answer this question, the team analyzed the system from an HSI perspective. Total system performance was assessed through the lenses of the nine HSI domains (Manpower, Personnel, Training, HFE, Safety, Occupational Health, Environment, Habitability, and Survivability), providing both a top-down and bottom-up approach to view weaknesses and problem areas. Using an HSI framework for the CBA provides a comprehensive look at the human element, answering how the human is affected by the CCAT system, and what needs to be done to optimize total CCAT system performance.

D. HUMAN SYSTEMS INTEGRATION PRINCIPLES

HSI is an interdisciplinary process that ensures that the human perspective is integrated into all phases of the system acquisition life cycle. HSI regards the human element as a key component in a system (Booher, 2003). An HSI practitioner views users, operators, maintainers, supporters, and supervisors in the same way an engineer views hardware and software. As with physical system components, humans have capabilities and limitations that must be accounted for when devising system requirements, defining quantitative measures of performance and effectiveness, and using appropriate metrics during test and evaluation (Booher, 2003). Furthermore, HSI looks at a system holistically and addresses the domains of Manpower, Personnel, Training, HFE, Safety, Occupational Health, Environment, Habitability, and Survivability. As a result, HSI extends the boundaries of the system engineering process by integrating the system with people and its organization (Booher, 2003).

The NPS Conceptual Model of HSI, shown in Figure 1, was developed by Drs. Lawrence and Nita Shattuck. It illustrates the relationship between HSI and the DoD

acquisition framework (Miller & Shattuck, 2008). The first three blocks of the model delineate the system inputs, enablers and constraints, and first order outcomes. These factors all affect the final outcome, which is total system performance. During system design and development, system inputs usually come from the Manpower, Personnel, Training, and HFE domains. These factors are formulated based on standards, formulas, models, regulations, and expertise (Miller & Shattuck, 2008). Developmental costs, delivery schedule, and design risks are either constraints or enablers that affect the process.

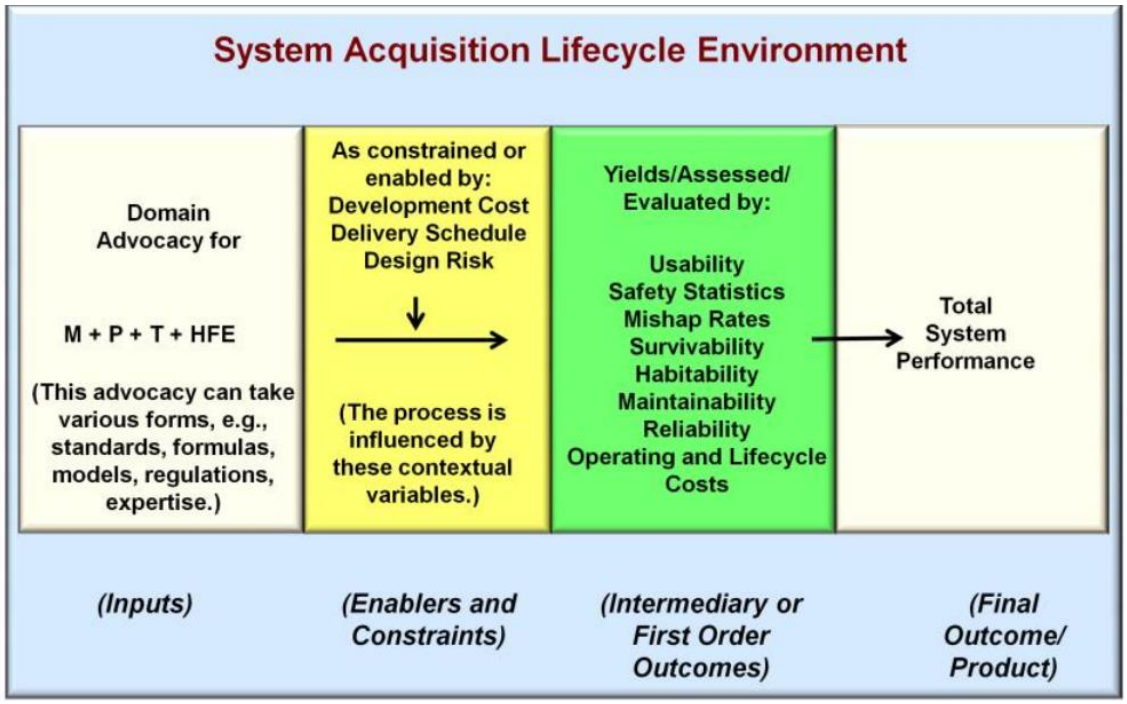

Figure 1. Conceptual Model of HSI (From Miller & Shattuck, 2008)

The enablers and constraints dictate what tradeoffs are made. During system design and development, it is important to acknowledge each tradeoff and calculate the consequences of each tradeoff decision. Effective HSI requires an understanding of possible first-order outcomes and their impact on total system performance. A small deliberate change to one domain may cause a large unintentional change in another. Thus, it very important to determine how the HSI domains interact with one another and identify which domains have strong relationships. This knowledge allows the HSI

practitioner to advise the program manager, sponsors, decision makers, and top-level leadership on the potential outcomes of each tradeoff decision. Finally, this model illustrates the importance of valid and reliable measures of all first-order outcomes.

According to Booher, "the dramatic reductions in costs, both human and financial, and the dramatic increases to performance and productivity are most likely to appear when the focus is upon the human element inherent in the system" (Booher, 2003, p. 2). These benefits are one of the reasons that HSI is mandated by the DoD policy. Specifically, DoD Directive 5000.01 requires each program manager to "apply HSI to optimize total system performance (hardware, software, and human), operational effectiveness, and suitability, survivability, safety, and affordability" (Under Secretary of Defense (AT&L), 2003, p. 10). DoD Instruction 5000.02, Enclosure 8 provides further guidance regarding HSI, which requires program managers to develop an HSI plan and mandates it be documented in the Acquisition Strategy and Systems Engineering Plan (Under Secretary of Defense (AT&L), 2008).

Each branch of the United States military has its own way of meeting this HSI mandate that is, to some extent, tailored to its specific organizational needs. Over the past several years, the USAF has made great strides in developing and implementing HSI principles into its Integrated Life Cycle Management (ILCM) process. In 2006, the Air Force Human Systems Integration Office (AFHSIO) was created to provide strategic-level support and direction to ensure proper execution of HSI at all levels of USAF acquisitions (Directorate of Human Performance Integration Human Performance Optimization Division, n.d.).

In 2008, the 711th Human Performance Wing (HPW) was formed; it is comprised of three tactical-level organizations: the Human Effectiveness Directorate (HPW/RH), USAF School of Aerospace Medicine (USAFSAM), and HPW/HP. Focusing on the warfighter, these organizations work together to "advance human performance in air, space, and cyberspace through research, education, and consultation" (USAF 88 ABW Public Affairs, 2012). The HPW/HP is the driving force behind implementation of USAF HSI policy and practices. The HPW/HP staff works closely with acquisition professionals, system engineers, sponsors, decision-makers, and leadership "to optimize

warfighter capabilities through a human centric approach to system development, sustainment, and enhancement" (Directorate of Human Performance Integration Human Performance Optimization Division, n.d.).

In addition to the DoD acquisition policies on HSI, USAF program managers and systems engineers are required to comply with the Air Force Instruction 62–101/20–10. This instruction states that "the program manager shall employ HSI to incorporate manpower, personnel, training, human factors engineering, safety, occupational health, personnel survivability, and habitability considerations to contribute to total system performance (hardware, software, and human) and the reduction of total ownership cost across the life-cycle" (Secretary of the Air Force, 2013, p. 49). Additionally, program managers are encouraged to consult the Air Force HSI Handbook, HSI Requirements Pocket Guide, and HSI in Acquisition guidebooks. Currently, there is no standalone USAF HSI policy.

E. THESIS ORGANIZATION

The literature review provided in Chapter 2 discusses background information on the AE and CCAT systems, describes the CBA process, and introduces the HSI TTAMs used during the analysis process. The method section (Chapter 3) provides an overview of the analysis team's timeline, describes the study participants, and explains the data collection procedures. The remaining chapters document each step of the CBA process and provide explanations on how the HSI perspective was used in the needs analysis, gap analysis, and risk analysis. The recommendations section provides a summary of the CBA findings in the form of prioritized HSI domain and DOTmLPF-P recommendations. The conclusion of this thesis provides lessons learned and recommendations for future research.

II. LITERATURE REVIEW

A. AEROMEDICAL EVACUATION OVERVIEW

One of the core competencies of the USAF is "rapid global mobility" (Secretary of the Air Force, 1998, p. 1). General Charles T. Roberston, a former Commander of the United States Transportation Command (USTRANSCOM), describes air mobility as a three-part process "A, to take the troops to fight; B, to support them while they are at the fight; C, to bring them home when the fight is over" (Secretary of the Air Force, 2011, p. 1). The component of the USTRANSCOM responsible for the coordination, execution, and support of USAF air mobility operations is the Air Mobility Command (AMC) (Secretary of the Air Force, 2011).

A main mission area of AMC is AE, which provides "timely and effective transportation of the sick and wounded to medical facilities offering appropriate levels of care" (Secretary of the Air Force, 2003, p. 6). AE is conducted in a wide-range of military operations, including major theater wars, contingency and crisis response, peacetime operations, and humanitarian and disaster relief (Secretary of the Air Force, 2003). The AE system is comprised of many subsystems and mission success depends on all these components working together.

The AE system also plays an important role in the joint environment and is an essential component of the Joint En Route Casualty Care System (JERCCS). JERCCS supports the third pillar of the joint Force Health Protection (FHP) health support system (Figure 2) by providing the warfighter with quality casualty care and management during deployment (Secretary of the Air Force, 2011).

Figure 2. Force Health Protection Pillars (From Joint Chiefs of Staff, 2001, p. I-1)

The five phases of casualty care are medical first responders, forward resuscitative surgery, theater hospitalization, en route care, and care outside the theater (Joint Chiefs of Staff, 2001). Figure 3 illustrates this process.

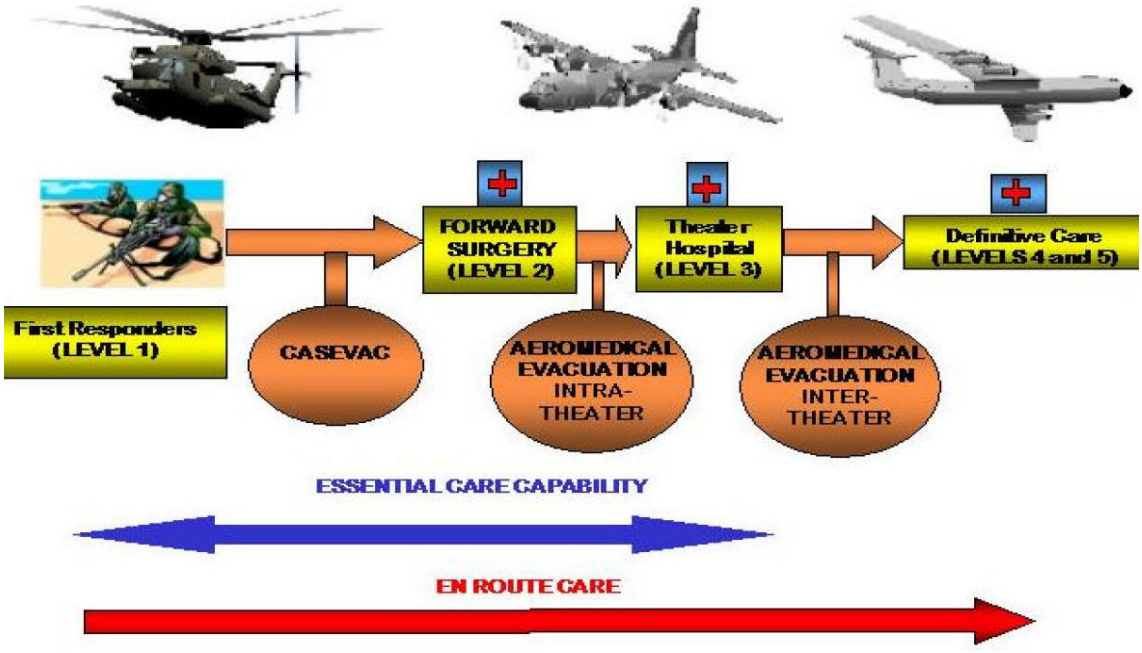

Figure 3. JERCCS Process (From Secretary of the Air Force, 2011, p. 27)

When a warfighter is wounded, first responders provide Level I care, which consists of basic "emergency lifesaving measures" at the point of injury (Secretary of the Air Force, 2011, p. 75). First responders are combat medics or personnel trained in "enhanced first aid" (Walter Reed Army Medical Center, 2004, p. 2.1). Forward resuscitative surgery is usually conducted at Level II care facilities that conduct "life- and limb-saving" medical procedures to stabilize the patients before evacuation (Secretary of the Air Force, 2011, p. 26). Level II care can be administered by Army Forward Surgical Teams, USMC Surgical Company, USAF Mobile Field Surgical Teams, USAF Expeditionary Medical Support, or aboard Navy Casualty Receiving and Treatment Ships. The theater hospital is a Level III care facility that is typically in a "reduced-level enemy threat environment" (Secretary of the Air Force, 2011, p. 75). Level I and Level II care usually involves more of the "crisis aspects of initial resuscitative care," whereas Level III treatments entail the "restoration of functional health" (Secretary of the Air Force, 2011, p. 75). Level IV and V care consist of "restorative and rehabilitative" medical procedures and treatments (Secretary of the Air Force, 2011, p. 75). Level IV care facilities are in "mature theaters," whereas Level V care facilities are military, civilian, or host nation hospitals that are located outside the threat environment (Secretary of the Air Force, 2011, p. 75).

En route teams provide the warfighter with a "continuum of essential care" while being transported to different levels of care (United States Air Force, 2011, p. 26). Patient movement is conducted either by casualty evacuation (CASEVAC), medical evacuation (MEDEVAC), or AE. Typically the CASEVAC and MEDEVAC flights handle transport to and from Level I and II care facilities; however, AE flights are capable of operating "as far forward as fixed-wing aircraft are able to conduct air/land operations" (Secretary of the Air Force, 2003, p. 6).

B. CRITICAL CARE AIR TRANSPORT OVERVIEW

The Critical Care Air Transport (CCAT) system is a subsystem of AE. The CCAT system provides medical care for Intensive Care Unit (ICU) patients during AE flights. A CCAT team usually consists of a critical care physician, critical care nurse, and

respiratory therapist (Beninati, Meyer, & Carter, 2008). CCAT members are active duty, reserve, or Air National Guard (ANG) personnel.

The CCAT mission, founded in 1994, has significantly improved the U.S. patient survivability rates and has saved thousands of lives (Beninati, Meyer, & Carter, 2008). The CCAT teams are "supplementation packages" to the AE medical crew, because they provide the advanced care needed to stabilize and support critically ill, injured, and burned patients (Secretary of the Air Force, 2006, p. 4). Without a CCAT team aboard, Aeromedical Evacuation Crew Members (AECM) can only transport and care for stabilized patients. With a CCAT team aboard, up to six unstable patients can be flown from an in-theater medical treatment facilities (MTF) to Level IV or V care facilities. CCAT teams care mostly for adult patients; however, they are equipped and trained to care for neonatal and pediatric patients (Secretary of the Air Force, 2006).

Even though the CCAT team escorts and cares for the patients in an aircraft, the members are designated as Operational Support Fliers (OSF) and are not considered part of the aircrew. CCAT personnel have aeronautical orders to participate in flight operations, but do not have specialized aircraft knowledge or formal flight training. This limitation requires them to work closely with the AECM, especially when preparing the aircraft cabin for flight, connecting medical equipment to the aircraft power sources, and providing oxygen support (Secretary of the Air Force, 2006).

During a mission, CCAT teams report to the AE Medical Crew Director (MCD). The MCD is responsible for the safe completion of patient movement operations and manages the medical teams aboard on the aircraft (Secretary of the Air Force, 2006). Furthermore, the MCD is the liaison between the flight crew and medical team. Although the CCAT physicians have "clinical authority" over critical care patients, the MCD consults with the aircrew and has final authority over all medically-related mission decisions (Secretary of the Air Force, 2006, p. 14).

Deployed CCAT teams are attached to an Expeditionary AE Squadron (EAES) and report to the EAES CCAT Director (Secretary of the Air Force, 2006). The CCAT Director is responsible for the overall management of the CCAT team, which includes advising the EAES Commander on all CCAT-related issues.

As shown in Figure 4, CCAT tasking begins with an MTF creating a patient movement request (PMR) (Secretary of the Air Force, 2003). The PMR is sent to the Patient Movement Requirement Center (PMRC), which evaluates all medical assets and determines the most appropriate mode of transfer. If CCAT is the best option, the request is sent to the Tanker/Airlift Control Center (TACC). The TACC is responsible for the operational planning, scheduling, tasking, and coordination of AE and CCAT missions. The TACC will notify the AEAS and the designated AE and CCAT teams will be notified.

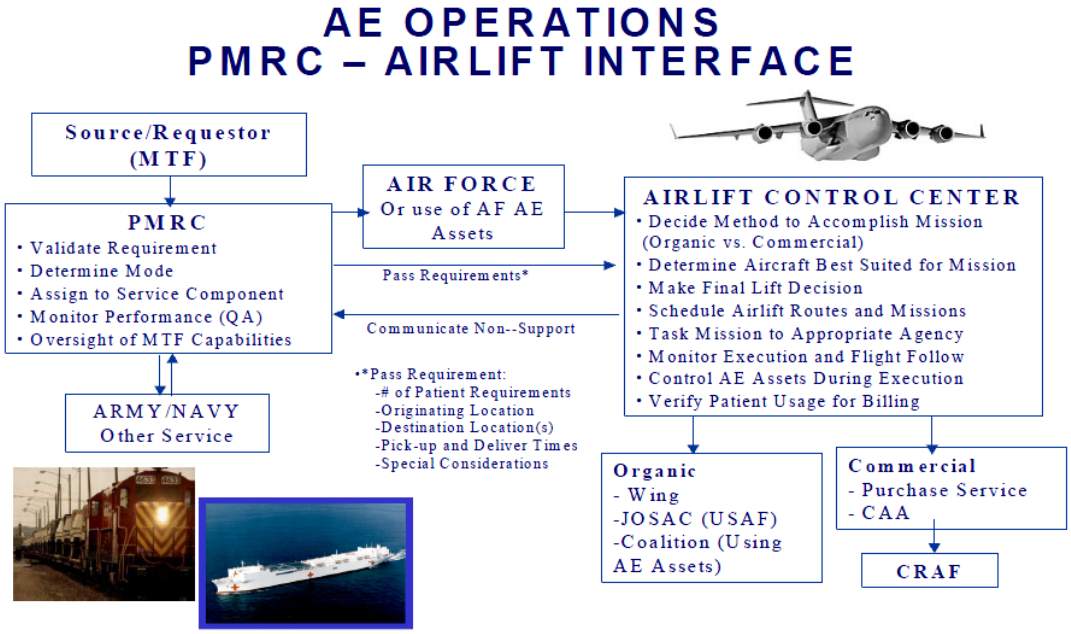

Figure 4. AE and CCAT Tasking Process (From Secretary of the Air Force, 2003, p. 18)

The CCAT mission profile is unlike that of a ground-based hospital. CCAT members must possess the knowledge, skills, and abilities to provide medical care to ICU patients, and being able to do so under pressure in an airborne environment. A typical CCAT mission can be divided into three phases: preflight, inflight, and post flight. Figure 5 illustrates the typical sequence for a CCAT mission.

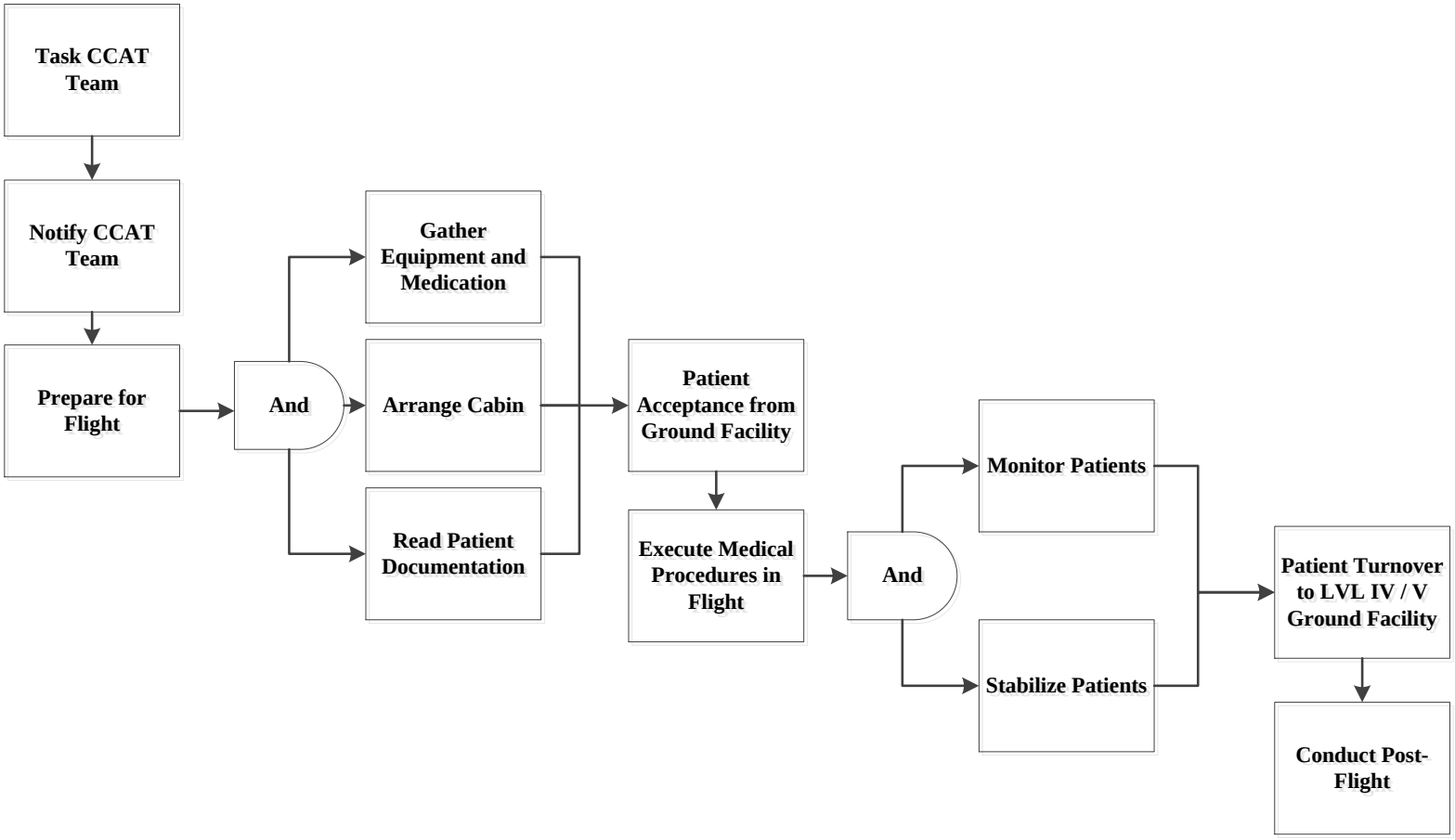

Figure 5. CCAT Mission Sequence

During preflight, the CCAT team and AECM prepare for the mission by gathering equipment and medication, arranging the cabin, and reading patient documentation if it is available. Typically, the patient is transferred from the in-theater MTF via bus to the aircraft. The CCAT team accepts the patients, and with assistance from the AECM, the patients are loaded and secured in the aircraft. While en route to the Level IV or V medical care facility, the CCAT team monitors and stabilizes the patients. After landing, the CCAT team turns over the patients to the ground personnel and conducts the post-flight activities, which include mission debrief, sanitation of medical equipment, and completion of the mission report.

The demanding and intense nature of this job limits the labor pool and imposes strict requirements for personnel eligibility and selection. As shown in the concept map in Figure 6, the USAF Expeditionary Medical Skills Institute administers the selection process in accordance with the AFTTP 3–42.51 Instruction. CCAT candidates must receive a nomination from their commanders, submit a selection review package, and complete a structured interview (Secretary of the Air Force, 2006). Three experienced CCAT members are hand-selected to sit on the Clinical Validation Committee (CVC).

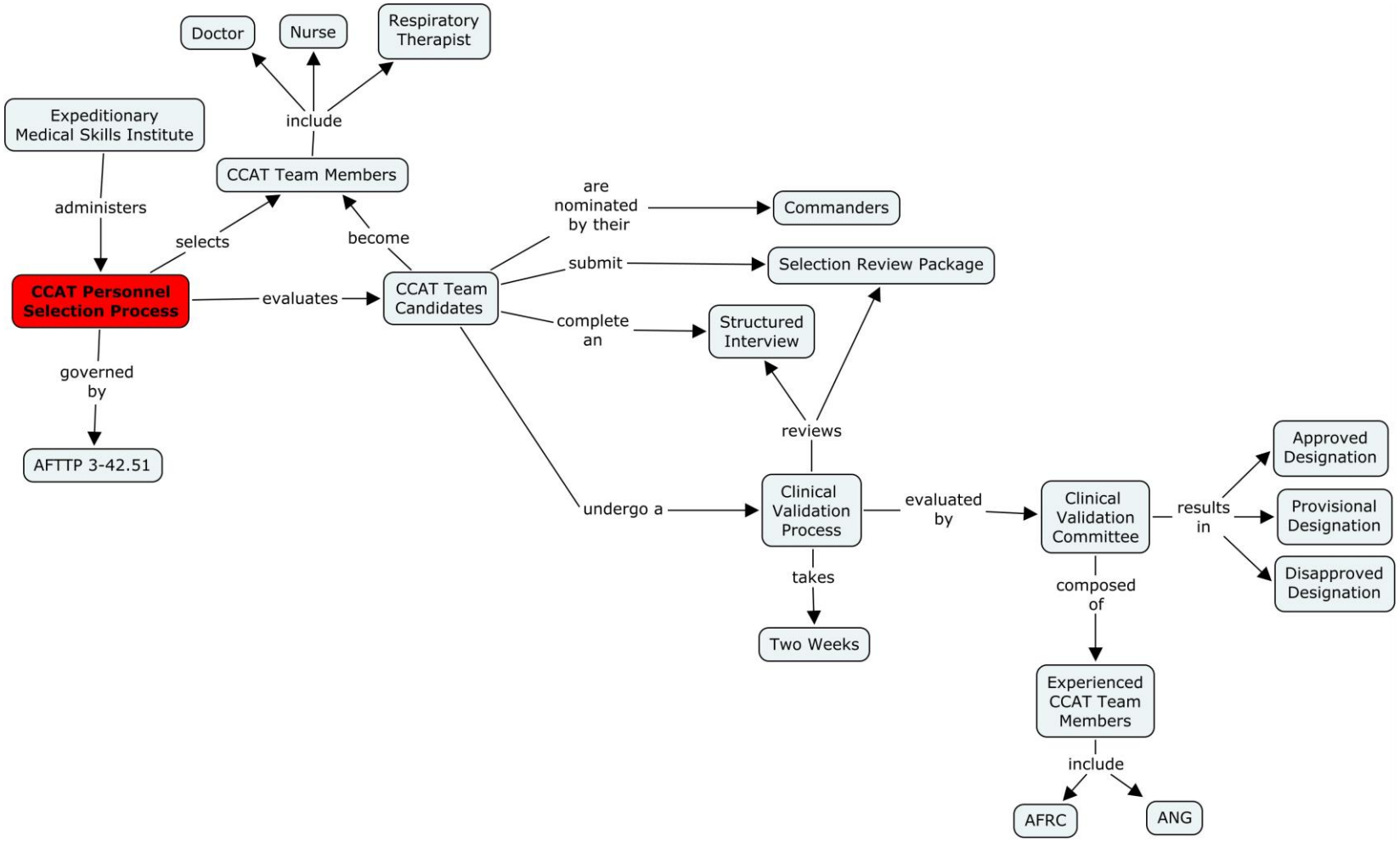

Figure 6. CCAT Personnel Selection Concept Map (After Secretary of the Air Force, 2006, pp. 7-11)

If a candidate meets all eligibility requirements, which are listed in Table 1, the CVC will approve his or her entry into formal training. The CVC disapproves candidates who do not meet eligibility requirements. Provisional designations are given to those candidates who must complete more training or information before an approved designation will be granted (Secretary of the Air Force, 2006).

Table 1. Eligibility Requirements for CCAT Applicants
(After Secretary of the Air Force, 2006, pp. 39-41)

Eligibility Requirements		
Critical Care Physician	**Critical Care Nurse**	**Respiratory Therapist**
Curriculum Vitae	Current Resume	Current Resume
Hospital Privilege List (AF Fm 1562)	Current Nursing Job Description	Documentation of award of 5 skill-level or higher
Medical License(s)	2 References	Phase II Training Certificate
Basic Life Support Certificate	Nursing License(s)	Certified Respiratory Therapist Certificate
Advanced Cardiac Life Support Certificate	Basic Life Support Certificate	Respiratory License
Advanced Trauma Life Support Certification	Advanced Cardiac Life Support Certificate	Basic Life Support Certificate
Pediatric Advanced Life Support Certification	Additional certifications	Advanced Cardiac Life Support certificate
Readiness Skills Verification Checklist	Readiness Skills Verification Checklist	Readiness Skills Verification Checklist
800 Hours of active Critical Care Patient Management experience within the past 2 years.	800 Hours of active Critical Care Patient Management experience within the past 2 years.	800 Hours of active Critical Care Patient Management experience within the past 2 years.
Able to attain Operational Support Flier status	Able to attain Operational Support Flier status	Able to attain Operational Support Flier status
Secret Clearance	Secret Clearance	Secret Clearance

The CCAT training pipeline consists of initial and sustainment training. Initial training and designation as OSF is conducted during the CCAT Basic Course, which is conducted by the USAFSAM. The objective of this training is to learn and develop the

skills needed for mission accomplishment. During the Basic Course, CCAT personnel are briefly exposed to the flight environment. Sustainment training is conducted prior to deployment in order to validate medical readiness and currency. The Centers for Sustainment of Trauma and Readiness Skills (C-STARS) are responsible for conducting this training and validating personnel for deployment (Secretary of the Air Force, 2006).

C. OVERVIEW OF JCIDS AND CBA PROCESS

The Joint Requirements Oversight Council (JROC) uses the Joint Capabilities Integration and Development System (JCIDS) to "balance joint equities and make informed decisions on validation and prioritization of capability requirements" (Chairman of the Joint Chiefs of Staff, 2012, p. 1). One of the first steps in the JCIDS process is conducting a CBA. The purpose of the CBA is to compare the current capabilities to what will be needed in the future to determine the potential capability gaps (Joint Capabilities Integration and Development System, 2012). A CBA must be conducted in accordance with the Chairman of the Joint Chiefs of Staff Instruction 3170.01H Joint Capabilities Integration and Development System and the Manual for the Operation of the Joint Capabilities Integration and Development System. Additionally, the Capabilities-Based Assessment User's Guide (2009) and Pre-Materiel Development Decision Analysis Handbook (2010) provide further guidance and direction.

The CBA is extremely important. Starting in the upper left corner of Figure 7, the findings from the CBA are used as inputs for the Initial Capabilities Document (ICD) or Joint DOTmLPF-P Change Recommendation (DCR) (Joint Capabilities Integration and Development System, 2012). Consequently, the information gathered and the knowledge gained during this process builds the foundation of the system. If this initial process is inaccurate or poorly developed, the system will not perform as needed, the nation's strategic guidance will not be upheld, and valuable resources will be wasted.

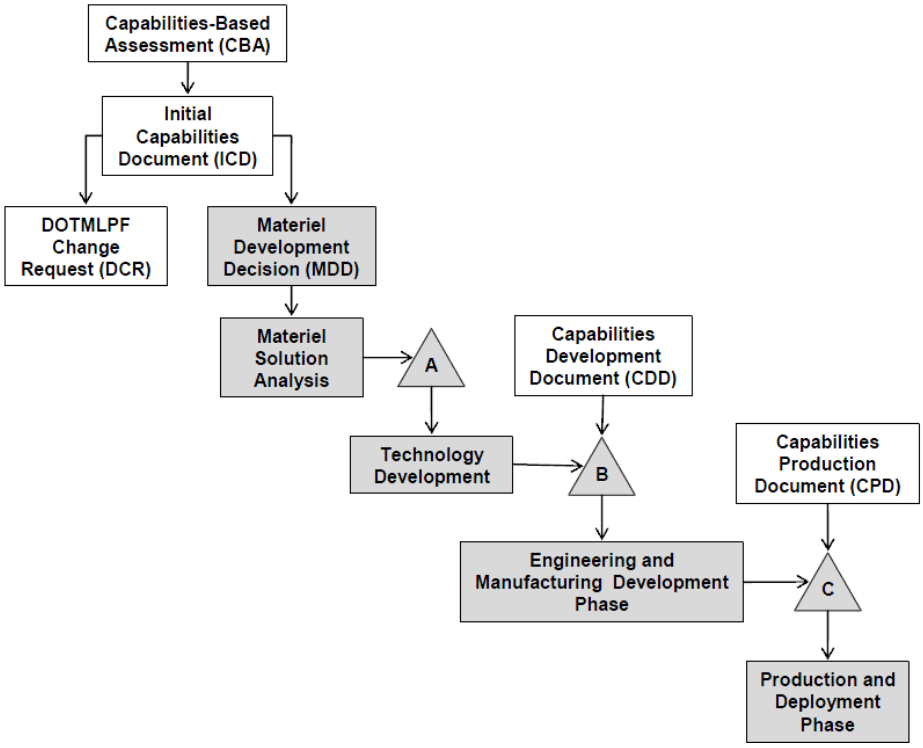

Figure 7. Acquisition Process (From Force Structure, Resources, and Assessments Directorate, 2009, p. 8)

The CBA process, illustrated in Figure 8, can be divided into 5 distinct phases. Phase 1 prepares the analysis team for startup and defines the problem; Phase 2 examines the current capabilities; Phase 3 identifies and analyzes capability gaps; Phase 4 conducts a risk assessment on all gaps; and Phase 5 makes prioritized recommendations to fill the gaps (Force Structure, Resources, and Assessments Directorate, 2009).

Phase 1 begins with the formation of the analysis team and the team leader conducting an introductory meeting to discuss stakeholder expectations, budget, timeline, and other administrative details. A comprehensive literature review of applicable doctrine, standard operating procedures, guidelines, and policy is conducted so each member has a general understanding of the routine procedures, basic actions, and system requirements (Force Structure, Resources, and Assessments Directorate, 2009). The literature review typically includes a close reading of all strategic guidance to ensure the assessment efforts are traceable back to these documents. The knowledge gained from the literature review helps team members define and scope the problem. Once the team

members have a solid understanding of the problem, a formal problem statement is routed to the sponsors to ensure the team's intentions meet their expectations.

Phases 2 and 3 focus on identifying the current capabilities, the future needs, and the capability gaps. One way to gather this information is collecting data from subject matter experts (SME). During this phase, the analysis team identifies and contacts credible SME. The knowledge gained from the SME supplements the analysis team's research. It is important that the SME used in the CBA are representative of the target population and that they provide a wide-range of perspectives including adversary expertise, analytical ability, bureaucratic agility, communications ability, doctrinal knowledge, study design experience, study management skills, cost estimation, technical knowledge, and policy knowledge (Force Structure, Resources, and Assessments Directorate, 2009). The SME help identify, verify, and validate capability requirements and gaps.

One way to assess current and future capabilities is to use a diverse set of scenarios that reflect the nation's strategic guidance, potential operational and threat environments, different mission tempos, and possible advances in enemy tactics and weaponry (Force Structure, Resources, and Assessments Directorate, 2009). The analysis team gathers qualitative data from SME as they work through each scenario. A needs analysis compares the current capabilities against the future capabilities to determine where the gaps are located (Chairman of the Joint Chiefs of Staff, 2012).

Phase 4 consists of a risk analysis to determine the probability and severity of each gap if left unfilled. These quantitative measures of risk help determine the most important gaps. During Phase 5, the analysis team provides recommendations to mitigate the high-risk gaps, and SME assist in a trade-off analysis to prioritize them (Joint Capabilities Integration and Development System, 2012). Upon completion of the CBA process, a formal report is submitted to the project's sponsor to determine whether an ICD or DCR is needed.

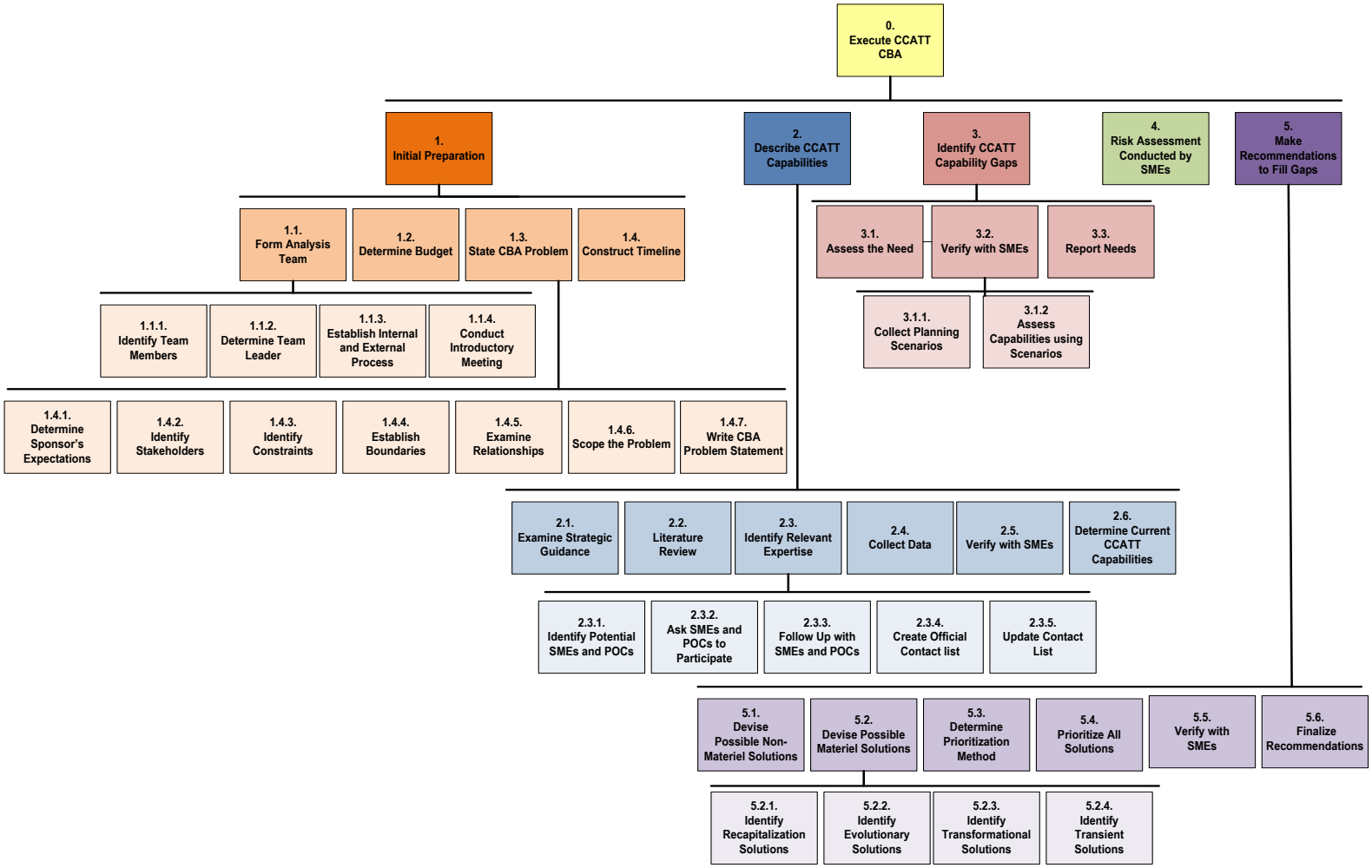

Figure 8. A Hierarchical Task Analysis (HTA) of the CBA Process
(After Force Structure, Resources, and Assessments Directorate, 2009)

D. OVERVIEW OF HSI TOOLS, TECHNIQUES, APPROACHES, AND METHODS (TTAMS) USED

Each CBA is different; therefore, it is important for HSI practitioners to be familiar with an array of HSI TTAMs. This knowledge allows an analysis team to customize and select TTAMs based on the constraints of the study. Appendix A contains a TTAMs library, which contains most, if not all applicable HSI TTAMs needed to conduct a CBA.

1. Knowledge Elicitation TTAMs

When conducting a CBA, research and literature reviews are critical when a research team lacks experience in a particular mission area. Research and literature reviews enhance knowledge by creating new perspectives, identifying historical trends, providing lessons learned, determining relationships, and improving awareness. The downside of research is that it requires time, patience, and focus. Unfortunately, budget, schedule, and manpower constraints limit how much research can actually be accomplished.

During the CBA process, SME help identify requirements, gaps, and recommended solutions to fill the gaps. Collecting this type of qualitative data can be accomplished using several knowledge elicitation methods. Interviews are used to collect verbal data from personnel. Interviews can be structured, using a bank of closed- and open-ended questions, or can be unstructured where a "think aloud protocol" is used (Kirwan & Ainsworth, 1992, p. 410). Focus groups are useful during the CBA process because they bring together individuals with different perspectives. Focus groups can generate large amounts of data in a short amount of time. Although there is usually an overarching topic, this TTAM is meant to facilitate discussion and group members are encouraged to speak freely. The disadvantage of interviews and focus groups is the large amount of data that can be collected, which requires a great deal of time to analyze.

During the CBA process, concept maps can elicit knowledge by revealing relationships among CBA stakeholders, tasks, objectives, constraints, and boundaries. Concept maps pinpoint natural groupings and relationships between concepts by using a hierarchical framework to organize knowledge (Novak & Canas, 2008). Broad concepts

are decomposed into smaller ones, which provide a visual representation of the flow of information. This process helps define and scope the problem. Additionally, concept maps can be used as a traceability matrix and may help teams construct a CBA schedule.

2. Task Simulation

The CBA User's Guide recommends using scenarios to pinpoint capability gaps, which is why the task simulation TTAMs are useful during this process. Table-top discussions are used to collect information from a group of SME who are asked to discuss a specific task or scenarios (Kirwan & Ainsworth, 1992). This TTAM allows SME to speak freely while working through a task or scenario.

The walk-through and talk-through TTAMs are used when an individual discusses how specific tasks are completed (Kirwan & Ainsworth, 1992). A walk-through centers the dialogue on a demonstration of how specific tasks are completed using the actual system, prototype, or mockup (Kirwan & Ainsworth, 1992). During a talk-through, an individual discusses how specific tasks are completed (Kirwan & Ainsworth, 1992). These TTAMs can be conducted in real-time or by using a step-by-step breakdown. A disadvantage of the Task Simulation TTAMs is that it requires a lot of work on the front end of the project, especially if the CBA requires multiple scenarios.

3. Hierarchical Task Analysis

An HTA "provides an effective means of stating how work should be organized in order to meet a system's goals" (Kirwan & Ainsworth, 1992, p. 101). A HTA usually consists of a functional decomposition, which break down function into tasks (Kirwan & Ainsworth, 1992). This decomposition reveals relationships between system tasks and sub-tasks, and determines if there are any problem areas that could lead to capability gaps. Tasks are organized using a hierarchical framework to determine the relationship and order of each task and sub-task. This TTAM is useful during the CBA process because it can be used to analyze the current system capabilities. It can also be used as an organizational tool that can divide work, allocate resources, and track the team's progress.

This chapter provided an overview of the AE and CCAT systems, and described their role in the joint environment. The literature review explained how a CCAT mission is typically executed and presented background information on the CCAT personnel selection process and training programs. Additionally, this chapter examined the JCIDS CBA process and described several HSI TTAMs that are applicable to this study. The next chapter explains the method used to conduct the CCAT CBA.

III. METHOD

A. PARTICIPANTS

The participants in this study were SME in AE or CCAT missions. Potential SME contact information was obtained using a list of individuals who participated in the AE/CCAT FEA process and through networking by the analysis team. Most of the SME identified for this study had a history of providing assistance or were involved in the AE/CCAT FEA, and all were familiar with this study's purpose. SME were contacted to participate via email by the study's Principal Investigator. Thirty SME volunteered to participate.

The analysis team determined that this convenience sample of thirty was adequate for this study. As shown in Table 2, all eight CCAT organizations and all levels of the CCAT system were represented by at least one SME. These organizations included: 445th Unit Air Force Reserve Command (AFRC); Headquarters AFRC; Headquarters ANG; Headquarters AMC; C-STARS; 59th Medical Wing Pilot Unit; 88th Air Base Wing; and USAFSAM. Additionally, the study's sample represented all roles within the CCAT system including CCAT team members (physicians, nurses, and respiratory therapists); supporters; leadership; and decision makers. Furthermore, six HSI practitioners from 711th HPW/HP and one researcher from 711th HPW/XPH participated in the study. The 711th HPW/HP HSI practitioners' primary role was to help the CBA analysis team facilitate discussions by asking HSI-related questions about the CCAT system. The 711th HPW/XPH researcher provided the CBA analysis team up-to-date information about AE and CCAT studies

Table 2. SME Rank, Organization, and Role

#	Rank	Organization	Role
1	O-6	Headquarters AFRC	AE Leadership
2	E-9	Headquarters AFRC	AE Leadership
3	O-6	445th AFRC	AE Leadership
4	O-5	445th AFRC	CCAT Leadership
5	O-6	AMC	CCAT Leadership
6	O-6	AMC	CCAT Leadership
7	O-5	AMC	Physician
8	O-5	AMC	Nurse
9	O-5	Headquarters ANG	AE Leadership
10	O-6	Headquarters ANG	AE Leadership
11	O-6	Headquarters ANG	Physician
12	E-7	Headquarters ANG	Respiratory Therapist
13	O-6	88th Air Base Wing	Physician
14	O-4	59th Medical Wing Pilot Unit	Physician
15	O-5	C-STARS Cincinnati	Physician / CCAT Instructor
16	O-5	C-STARS Cincinnati	Physician / CCAT Instructor
17	O-5	C-STARS Cincinnati	Nurse / CCAT Instructor
18	O-4	C-STARS Cincinnati	CCAT Instructor
19	O-4	USAFSAM	Nurse / CCAT Instructor
20	O-3	USAFSAM	Nurse / CCAT Instructor
21	E-7	USAFSAM	Respiratory Therapist / CCAT Instructor
22	E-6	USAFSAM	Respiratory Therapist / CCAT Instructor
23	O-6	USAFSAM	Physician / Research
24	O-5	USAFSAM	Nurse / Research
25	O-4	711th HPW/XPH	Nurse / Research
26	O-3	711th HPW/XPH	Nurse / Research
27	E-9	711th HPW/XPH	Respiratory Therapist
28	O-4	711th HPW/XPH	Research
29	O-5	AFMSA	CCAT Leadership
30	O-5	AFMSA (Royal Air Force)	International

B. MATERIALS

The following were materials required for this study:

- Audio and visual equipment for teleconferences
- Projector
- Computers
- Audio recorders

All software programs used for this study were freely available to the DoD. The following software programs were required for this study:

- Audio and visual software for teleconferences
- Microsoft Excel
- Microsoft Word
- Microsoft Office
- Institute of Human and Machine Cognition (IHMC) CmapTools

C. PROCEDURES

The analysis team was given a year to complete the CBA process. One of the first tasks the team completed was the construction of the schedule. As shown in Table 3, the schedule was divided into quarters starting from September 2012 to September 2013.

The structure of the schedule coincided with the five phases of the CBA process. Specifically, during the first quarter, the analysis team conducted start-up activities which prepared them for the CBA processes. These activities included team formation, completion of all administrative tasks, problem definition, literature review, and identification of potential SME.

The next three quarters were dedicated to collecting qualitative and quantitative data from the SME. During January 2013 through September 2013, 30 SME participated in interviews and discussions regarding the CCAT mission. Knowledge elicitation methods such as structured and unstructured interviews gathered information from the SME. Task simulation methods such as table-top analysis and talk-through protocols were used during the scenario-based discussions. HTAs were used to break down broad capabilities into smaller functions and tasks.

Table 3. CCAT CBA Schedule

Quarter	Month	Phase	Actions	Activities
Startup	Sep-12	1	Form CBA analysis team	Kick-off meeting
1	Oct-12	1	Scope and write a problem statement	
	Nov-12	1	Form a team of subject matter experts	
			Find or develop scenarios	
	Dec-12	1	Holiday break	
2	Jan-13	2	Strategize and evaluate project status	
	Feb-13	2	Identify capabilities necessary for scenarios	Technical Interchange Meeting 1
	Mar-13	2	Examining current capabilities	
3	Apr-13	3	Strategize and evaluate project status	
	May-13	3	Analyze capability gaps	
	Jun-13	3	Finalize Phase 3 actions	Technical Interchange Meeting 2
4	Jul-13	4	Assess operational risk	
	Aug-13	4	Identify methods to reduce operational risk	
	Sep-13	5	Make and justify recommendations	
			Write and submit final report	Final brief to sponsors

The analysis team prepared for the interviews and discussions by creating data collection worksheets, formulating questions, determining discussion topics, devising a schedule of events, and completing miscellaneous administrative tasks. Interviews and discussions were administered both individually and in small groups, and were conducted in person, over the phone, and through email. During the data collection, members of the analysis team acted as discussion facilitators, interviewers and note takers.

Before each interview or discussion, the standard protocol was for the team to introduce themselves, to explain the objectives and goals of that particular interview or discussion, and to distribute consent forms. Once the consent forms were signed, the interviews and discussions commenced. Verbal communication data was documented using hand-written notes and audio recordings. The analysis team asked participants to keep group interviews and discussions confidential.

Two SME workshops, entitled Technical Interchange Meetings (TIM), were held in February 2013 (second quarter) and June 2013 (third quarter). Both workshops were approximately two days long and took place at the Tec Edge Facility in Dayton, Ohio. The workshops included a combination of structured and unstructured interviews, table-top analysis, and talk-through protocols. The purpose of these workshops was twofold: to collect data in a group setting and to have the SME verify and validate the work of the CBA analysis team.

During the first TIM, SME developed scenarios based on current strategic guidance in order to identify current CCAT requirements and future needs. Upon completion of this TIM, the analysis team reviewed the qualitative data and compared the future needs to the capabilities of the current system. Next, the analysis team created four specific scenarios that covered traditional, irregular, catastrophic, and disruptive situations.

During the second TIM, the four future scenarios were validated by the SME. Additionally, the analysis team and the SME assessed whether the current capabilities met the future needs. If not, a capability gap was identified and the size of that gap was estimated using a Likert scale. The data gathered during the second TIM was used as

input into the risk analysis, which measured and assessed the probability and severity of the risks associated with the future gaps.

During the final quarter of the year-long CBA, the team constructed a recommendation matrix in order to prioritize HSI domains and DOTmLPF-P recommendations based on cost, schedule, risk, and performance. All results were verified by the SME via email and telephone. These findings were consolidated into a formal report and delivered to the 711th HPW/HP prior to September 30, 2013.

This chapter explained the CCAT CBA participants, methods, and procedures. The next four chapters describe chronologically how the analysis team conducted each step of the five-phased, HSI-focused CCAT CBA process.

IV. INITIAL PREPARATIONS

Phase 1 of the CBA process consisted of four steps: formation of CBA analysis team; determination of CBA budget; definition of CBA study; and construction of CBA timeline. These initial preparations were essential to conducting a successful CBA study because they established the team's operating principles and ensured the right problem was addressed.

A. TEAM FORMATION

The formation of the analysis team was the first step in Phase 1 of the CCAT CBA process. When tasked to conduct the CBA using an HSI perspective, the 711th HPW/HP formally contracted with two HSI experts from NPS, as well as a senior HSI Consultant with SURVIAC. The team also included a student enrolled in the HSI Master's degree program at NPS. These four individuals formed the analytic core of the team and were responsible for the design and execution of the CBA study. Two representatives from the 711th HPW/HP joined the team as advisors and were primarily responsible for monitoring CBA progress on behalf of the USAF.

1. Organizational Matrix

According to the JCIDS Manual, a CBA "should be conducted with a capable Joint team that can bring the necessary spectrum of expertise to bear on the problem" (Joint Capabilities Integration and Development System, 2012, p. A-B-1). The Team Lead followed the recommendations in the CBA User's Guide, and created an organizational matrix to track each team member's role and areas of expertise (Force Structure, Resources, and Assessments Directorate, 2009, p. 21). The purpose of this matrix was threefold: it helped the analysis team members become better acquainted with one another, it communicated the basic responsibilities of each team member, and it identified areas in which the team lacked the required level of expertise.

Table 4. CBA Analysis Team Organizational Matrix

	Team Member					
	1	**2**	**3**	**4**	**5**	**6**
Team Lead	X					
Deputy Team Lead		X				
Study Designer	X	X	X			X
HSI Practitioner	X	X	X	X	X	X
HSI Expert	X	X	X	X	X	
Analytical Ability	X	X	X	X	X	X
Bureaucratic Expert			X	X	X	
Communicator				X	X	
Military Experience	U.S. Army		U.S. Air Force	Royal Air Force	U.S. Air Force	U.S. Navy
Joint Perspective	X		X	X	X	X
International Perspective				X		
Medical Expertise				X		
Aeromedical Expertise			X		X	
Aviation Expertise				X	X	X
CBA Expertise	X					
AE/CCAT FEA Analyst			X			
CCAT Expertise						

As shown in Table 4, the CCAT CBA analysis team encompassed a sufficient breadth of knowledge, skills, abilities, and experience required for the CBA study. Each team member brought a unique perspective to the CBA process that would have otherwise been lost if the team was composed of individuals with similar backgrounds. The analysis team lacked operational experience in the CCAT mission; however; the HSI Consultant with SURVIAC was an analyst on the AE/CCAT FEA project and acquired valuable insight that directly transferred to the CCAT CBA. Originally, the HSI Consultant was not on the analysis team and was only contracted to assist with the turnover between SURVIAC and NPS. While debriefing the analysis team on the AE/CCAT FEA, the Team Lead realized that the knowledge the HSI Consultant had gained during the AE/CCAT FEA would be extremely helpful during the CBA process and would augment the CCAT operational expertise of the SME. The HSI Consultant was immediately hired to be a full-time member of the analysis team.

2. Introductory Team Meeting

In September 2012, the entire analysis team met for the first time at the 711th HPW/HP at Wright-Patterson Air Force Base (WPAFB) in Dayton, Ohio. The first day started with a tour of the 711th HPW/HP and the members of the analysis team were formally introduced. The HSI Consultant with SURVIAC debriefed the AE/CCAT FEA findings, the 711th HPW/HP team members explained the sponsor's expectations, and the team developed their operating principles. The second day was dedicated to discussing the CBA deliverables, major timeline milestones, and study definition.

3. Operating Principles

The team's operating principles formally established how the team conducted internal and external processes to include communication procedures, meeting times, and file transferring. The team members were located in different parts of the country; therefore the team was unable to meet face-to-face regularly. With this type of decentralized team organization, it was important to establish an effective communication and information exchange process.

The analysis team members communicated almost daily over email and participated in a weekly teleconference. A record of decisions (ROD) was drafted each week to document important information and to track the team's progression. The ROD was sent to all team members and the applicable sponsors. These ROD documents are in Appendix B.

Additionally, a monthly progress review (MPR) was conducted with the project sponsor. This regularly scheduled meeting provided the team an opportunity to reflect on what had been accomplished, adjust the schedule to meet upcoming deadlines, and address any concerns that may have come up since the last meeting. After the MPR, the two representatives from the 711 HPW/HP updated their chain of command.

File sharing was usually conducted using email. Sakai, a secure web-based collaborative portal hosted on the NPS server, was used when documents were too large to send via email. Another method for file sharing and storage was the CCAT HSI Toolbox, which contained a library of the HSI-related TTAMs needed for Pre-Materiel Development Decision activities, to include the CBA, ICD, and DCR processes. The toolbox was created using the IHMC CmapTools software and is explained further in Appendix A.

B. BUDGET

The budget allocated for the CCAT CBA covered the analysis team's salaries and travel expenses for site visits, team meetings, and TIMs. The Team Lead was ultimately responsible for maintaining the budget, but received assistance from a financial manager at NPS. Having the financial manager track and manage the budget enabled the Team Lead to better focus on the CBA activities.

C. STUDY DEFINITION

The third step in Phase 1 of the CCAT CBA process was the study definition. It consisted of seven tasks: determining sponsor expectations, identifying system components, identifying constraints, establishing boundaries, explaining the scope, examining relationships, and writing the problem statement. As shown in Figure 9, the

study definition process was like a funnel. The analysis team's initial direction for the CBA focused on the entire AE system. This broad scope narrowed sequentially as each of the seven tasks was completed. As a result, the analysis team limited the CBA scope to the CCAT system. At the conclusion of the study definition process, the analysis team wrote the problem statement, determined the CBA type, and developed the CBA methodology.

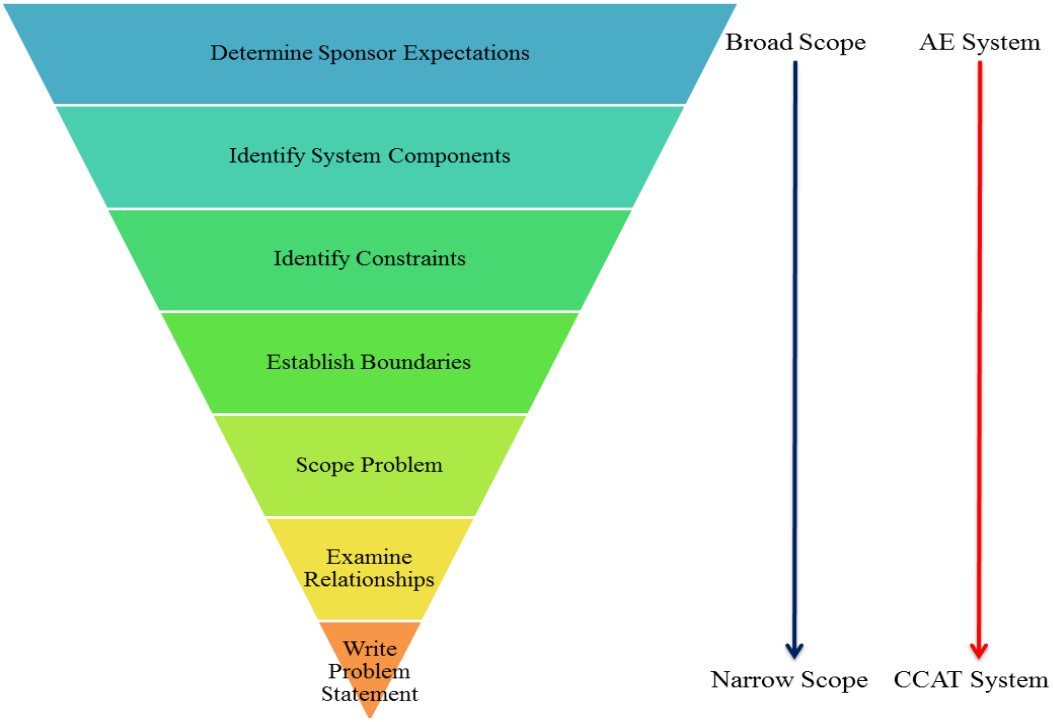

Figure 9. CCAT CBA Study Definition Process

1. Expectation of Sponsors

Prior to the introductory team meeting, the analysis team received little guidance from their sponsors. According to the CBA User's Guide, sponsors typically do not provide detailed instructions on how they expect a CBA to be conducted (Force Structure, Resources, and Assessments Directorate, 2009). Furthermore, analysis teams rarely have direct contact with their sponsors and must rely on their chain of command to pass information. Fortunately, the Team Lead eliminated these communication barriers by designating the two 711th HPW/HP representatives as the analysis team's bureaucratic

experts. Responsible for the first task in the study definition process, the bureaucratic experts met with the sponsors several times to communicate their expectations for the CBA.

The 711th HPW/HP representatives communicated four expectations to the entire analysis team at the introductory meeting in September 2012. First, the sponsors specifically requested the CBA be conducted from an HSI perspective. The sponsors recognized that the HSI framework was the best mechanism to bridge the medical, operational, research, acquisition, and engineering perspectives into a cohesive collaboration. Using an HSI approach eliminated the biases from the different disciplines so the CBA could be beneficial to all stakeholders involved in the aeromedical community. Furthermore, this HSI-focused CBA provided the 711th HPW/HP an opportunity to demonstrate how HSI can contribute to during the early stages of the USAF acquisition lifecycle.

Second, the CBA effort needed to be a "continuity between analyses" and complement the work being conducted throughout the 711th HPW without being redundant (Joint Capabilities Integration and Development System, 2012, p. A-3). Therefore, the sponsors expected the CBA analysis team to familiarize themselves with other studies and expand upon the existing knowledge base for aeromedical operations. In particular, the sponsors tasked the analysis team to use the AE/CCAT FEA findings as a starting point.

Third, the sponsors set a twenty-year time frame for the CBA and requested the analysis team use a visionary approach when analyzing the future of aeromedical operations. Additionally, the sponsors expected the analysis team to deliver actionable, prioritized, and financially feasible recommendations that would make the AE/CCAT system resilient to future changes.

Lastly, the CBA was to represent the "total force" perspective, including the active duty, reserves, and ANG. The sponsors expected the analysis team to consult each organization and incorporate organizational differences in the CBA analysis.

All in all, the sponsors granted the analysis team the freedom to develop its own methodology for the CBA study. The sponsors also delegated authority to the 711th HPW/HP Director to oversee the analysis team and CBA progress.

2. Identify System Components

Prior to the introductory meeting, the analysis team conducted an initial literature review to develop a broad understanding of the AE system. At this point in the CBA process, the analysis team had limited access to official USAF doctrine so it relied on the AE/CCAT FEA report for most of the background information.

After discussing the expectation of the sponsors at the introductory meeting, the analysis team conducted a brainstorming session to identify the AE system and sub-system components. The brainstorming session required continuous and open group dialogue, so it was helpful to have the entire team physically present at the same location.

The Team Lead was experienced at leading brainstorming activities and knew this unstructured technique would stimulate critical thinking and teamwork. The Team Lead encouraged team members to speak freely and emphasized that there were no right or wrong answers. The Team Lead started the session by asking the analysis team; "What is needed to conduct an AE or CCAT mission?" As the team members shouted out the components, the Team Lead wrote the terms on a whiteboard. As shown in Figure 10, there was no organization, form, or sequence to this initial list.

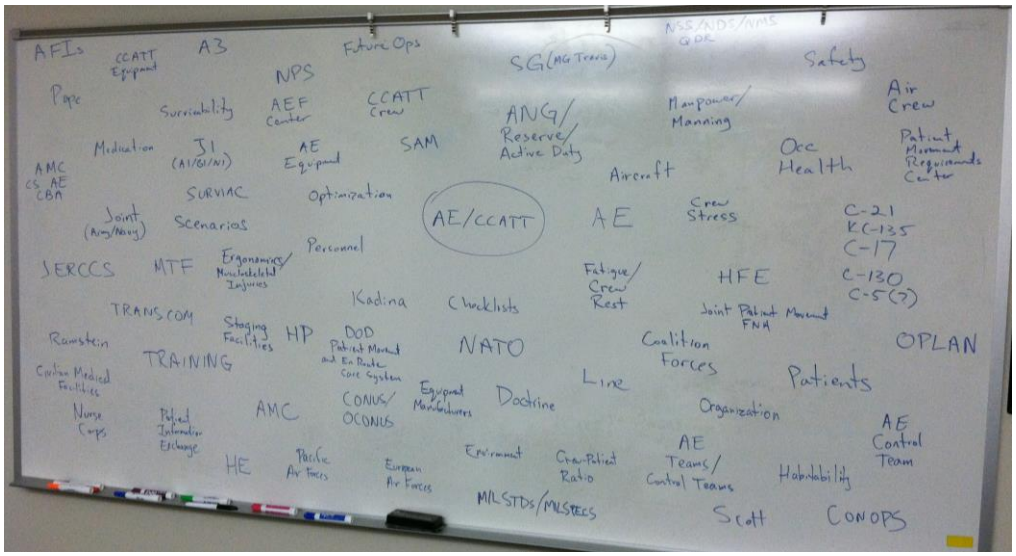

Figure 10. Initial List of CCAT System Components

3. Identify Constraints

After the AE system and subsystem components were listed, the analysis team discussed the constraints on the CBA project. The constraints of the CBA included the twelve-month deadline, budget, and capabilities of the analysis team. The analysis team concluded there was not enough time, money, or manpower to conduct a CBA on the entire AE system. As a result, and with the approval of the sponsor, the analysis team reduced the scope of the CBA problem to the CCAT subsystem of the AE system.

4. Establish Boundaries

In order to reduce the magnitude of the original tasking, the analysis team formulated a boundary between the AE system and the CCAT system. Focusing solely on the CCAT system fulfilled the sponsor's expectations while staying within the constraints of the study.

The justification for a boundary around the CCAT system was twofold. First, the AE/CCAT FEA findings confirmed a need for further examination of the CCAT system since 30% of the AOI related specifically to CCAT. An HSI-focused CBA would be extremely beneficial for the CCAT system because there were significant HSI implications associated with each of the AOI (as listed in Table 5).

Table 5. Summary of CCAT Areas of Interest

Summary of CCAT Areas of Interest (AOI)	
1	Misappropriation of CCAT resources by management
2	A lack of CCAT representation and voice at decision making level
3	CCAT team is a low-density/high demand resource
4	High task rate for CCAT team
5	CCAT personnel has difficulty maintaining training because of high task rate
6	Minimal team training for the CCAT team to include working with AE personnel
7	Obtaining clinical and ICU/Trauma experience is hard to maintain when not deployed
8	No analysis of current training requirements
9	Training requirements may not be realistic with current resource constraints
10	Doctrine is out of date
11	CCAT team are not always made aware of operational issue when deployed
12	Lack of command structure for CCAT system
13	No crew rest for CCAT team
14	Equipment is purchased with no input from CCAT teams
15	Lacking equipment standardization
16	Aging workforce
17	Injuries due to lifting patients and equipment
18	Heavy equipment
19	Multiple missions per day for CCAT team
20	CCAT teams are "quick resting" (sleeping in aircraft)
21	Dehydration
22	Injuries due to lifting patients and equipment
23	Aircraft noise
24	Low retention rates for CCAT personnel
25	Wasting resources on training CCAT personnel when they don't stay in the billet.
26	Lack of clinical proficiency
27	Some instructors have not deployed
28	No retention policy
29	CCAT personnel evaluations lack objective criterion and there are flight evaluations
30	The slow approval process for equipment is a frustration.
31	Inadequate equipment

A CCAT CBA would build upon the AE/CCAT FEA results, determine the root cause of the AOI, and formulate actionable recommendations to improve these human-centric issues. Additionally, the total force could still be addressed by a CCAT CBA since the active duty, reserves, and ANG all participate in the CCAT mission. As a subsystem of AE, any improvements to the CCAT system would have benefit the over-arching AE system.

Second, the 711th had research efforts involving certain aspects of the CCAT system, but had not conducted a comprehensive study on the entire CCAT system. Although a CBA had been conducted on the AE and JERCCS systems, the findings concentrated more on the AE system and did not have the detailed analysis necessary for making actionable recommendations for the CCAT system.

The analysis team established a second boundary between materiel and non-materiel solutions. The sponsor's expected recommendations that were actionable, prioritized, and feasible. Based on this requirement, the analysis team decided to deliver non-materiel recommendations in the form of DOTmLPF-P solutions.

The justification for this boundary was twofold. First, DOTmLPF-P solutions are typically faster, cheaper, and easier to implement. Unlike materiel solutions, DOTmLPF-P solutions do not have to go through the acquisition process or wait for new technologies to develop. Second, the DOTmLPF-P terminology was defined by the JCIDS manual and was more widely known than the HSI domains. However, this decision did not change the HSI approach since the DOTmLPF-P solutions linked directly to the HSI domains (Alfred, 2007). The relationships, illustrated in Figure 11, allowed the analysis team to translate the HSI language into common, more widely acceptable terminology.

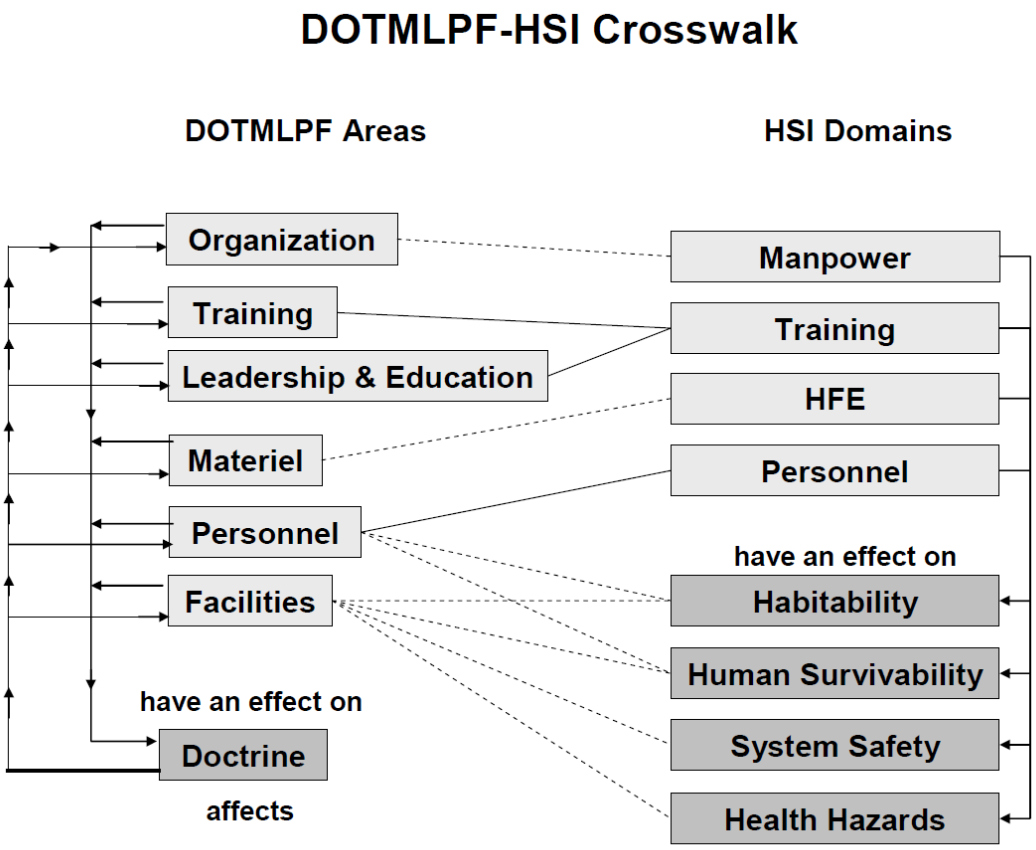

Figure 11. DOTMLPF-HSI Crosswalk (From Alfred, 2007, p. 8)

5. Scope the Problem

Establishing the boundaries of the problem narrowed the scope of the CBA, which included the system components within the CCAT system and emphasized DOTmLPF-P solutions. Reverting back to the brainstorming technique, the analysis team worked together to determine which system components belonged inside the CCAT system boundary. As shown in Figure 12, the "green dots" indicated components within the CCAT boundary, whereas the "red dots" indicated components outside the scope. Upon conclusion of the problem-scoping activity, the bureaucratic experts debriefed the 711th HPW/HP Director and obtained approval to scope the CBA to just CCAT. At this point, the introductory meeting concluded.

Figure 12. CCAT System Boundary

6. Examine Relationships

After the scope of the CBA was approved, the next task was to examine the relationships between the system components. Since the initial list lacked structure and organization, the analysis team used the IHMC CmapTools software to construct a concept map to reveal natural groupings and visualize how the different CCAT entities function together. Each of the system components was made into a node in the concept map. The first iteration of the concept map started as a "parking lot," which loosely groups words together to estimate the flow, form, and perspective of the map (Novak & Canas, 2008). An example of the CCAT Parking Lot, found in Figure 12, demonstrates how the analysis team grouped and loosely formatted some of the system components in accordance with the DOTmLPF-P boundary.

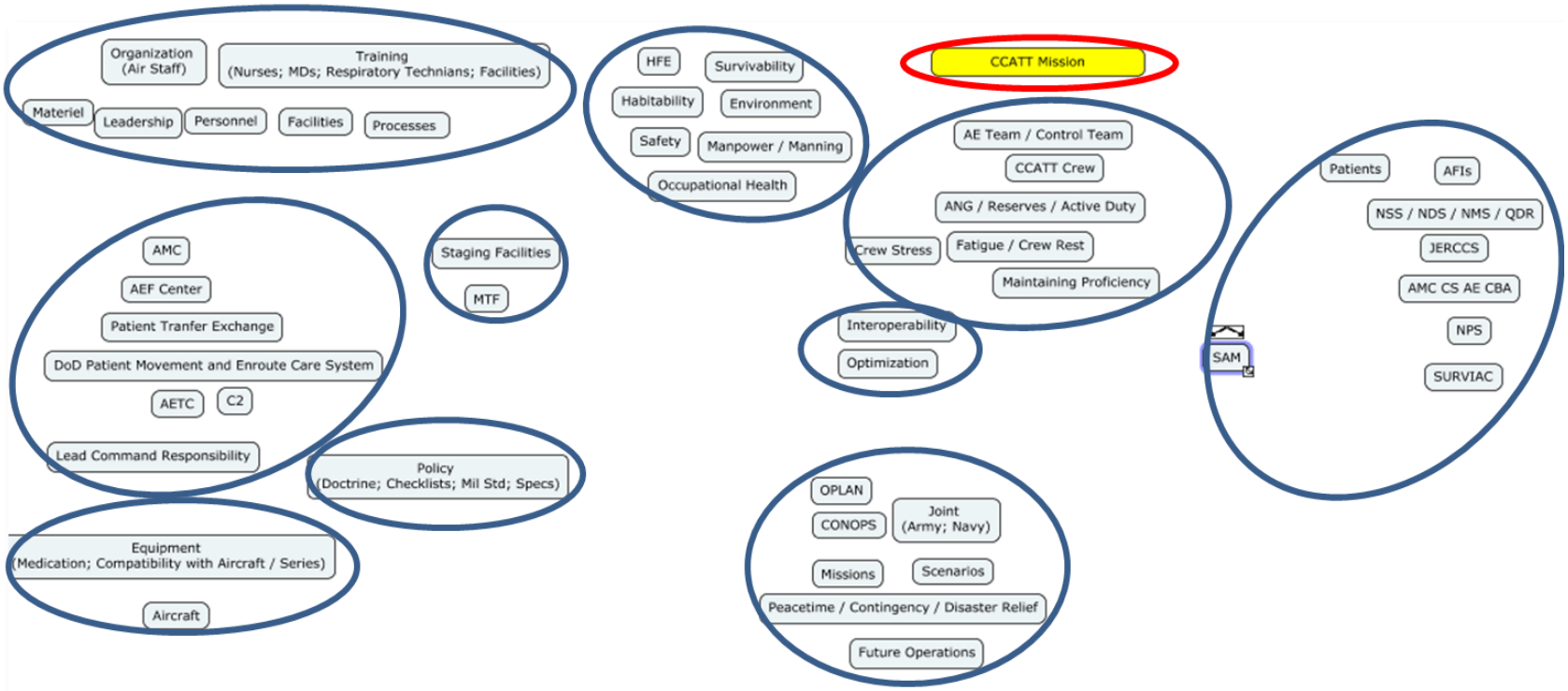

Figure 13. CCAT Parking Lot

Each system component became a node on the concept map. Using a subject-verb-predicate relationship, the analysis team connected the nodes. The construction was an iterative process and several versions were created during this initial scoping phase. As more research was conducted and new knowledge was gained, more relationships were formed and existing relationships were modified. The final revision to the CCAT CBA concept map is found in Figure 14 and the iterations are located in Appendix C.

The CCAT concept map was a very important TTAM and was used throughout the CBA process. As new knowledge was gained, the concept map was revised. It was used to develop the CCAT CBA timeline, provide the sponsor's with a visual representation of how the team was approach the problem, help assess the current capabilities, reveal gaps, and evaluate concepts contained in the CBA.

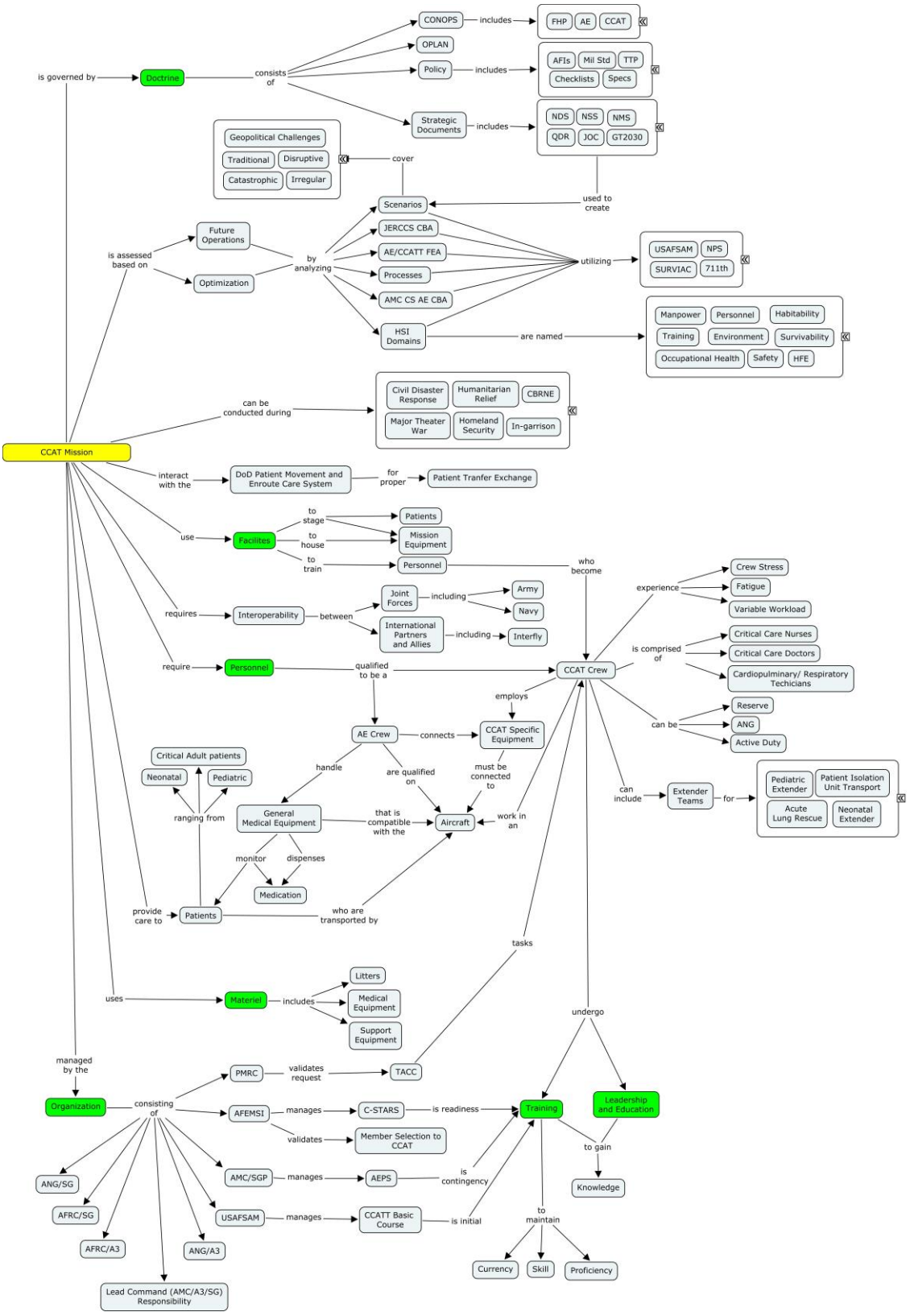

Figure 14. CCAT CBA Concept Map

7. Problem Statement

Once the concept map was created, the team began to write the problem statement. The problem statement needed to address the sponsor's expectations, the boundaries of the CBA, and explicitly list the deliverables of the CBA.

The analysis team took great care with word selection. The analysis team discussed the definition of each word used in the problem statement to ensure it fit the context of the problem and to verify it was the correct choice of words. Although the problem statement was only one sentence, it took several iterations before it could be finalized. These intermediate efforts are located in Appendix D. The following was the CCAT CBA problem statement:

> Using Human System Integration (HSI) principles, this study will identify current and future capability gaps in the CCAT system, provide prioritized Doctrine, Organization, Training, Materiel, Leadership Policy and Education, Personnel, Facilities, and Policy (DOTmLPF-P) recommendations that will close those gaps, optimize system performance, and minimize cost and risk.

8. CBA Type and Methodology

After completing the study definition process, the analysis team used the CBA taxonomy found in the CBA User's Guide to determine the CCAT CBA type. Determining the type of CBA helped the analysis team determine "the different implications for what the CBA must emphasize" and the specific CBA outputs (Force Structure, Resources, and Assessments Directorate, 2009, p. 11). Based on the sponsor's expectations and the problem statement, the analysis team determined the CCAT CBA was "to provide a unified look at a mission area" (Force Structure, Resources, and Assessments Directorate, 2009, p. 10). Based on the CBA type, the analysis team concluded that the best way to conduct the CBA methodology was by using a scenario-based approach and collecting data from SME.

D. SCHEDULE

According to the JCIDS Manual, a typical CBA study should be completed in twelve months (Joint Capabilities Integration and Development System, 2012). For the

CCAT CBA, the analysis team was given a timeline of twelve months, starting in September 2012.

The Team Lead was responsible for creating the schedule to keep the analysis team on track. Instead of using a work breakdown structure or Gantt charts, the Team Lead constructed the schedule using a concept map format. The CCAT CBA was created using the IHMC CmapTools software. There were many benefits to using this software. First, the software was free and easy to download off the internet. Second, the software converted the schedule to a JPEG format, making it easy to transfer it to individuals without the software. Third, the entire schedule fit neatly on one sheet of paper. In one glance, a sponsor or analysis team member knew what needed to be accomplished and what was on the horizon without having to examine multiple pages. Lastly, the user-friendly software made it easy to update the schedule.

The Team Lead consulted the JCIDS Manual and CBA User's Guide to determine the CBA output requirements and translated them into specific deliverables for the CCAT study. Referencing Figure 15, the Team Lead identified the concurrent tasks and sequenced the major deliverables in accordance with the guidance (Force Structure, Resources, and Assessments Directorate, 2009). Specifically, the analysis team performed background research, site visits, and interviews while simultaneously working on other Phase 1 and 2 tasks.

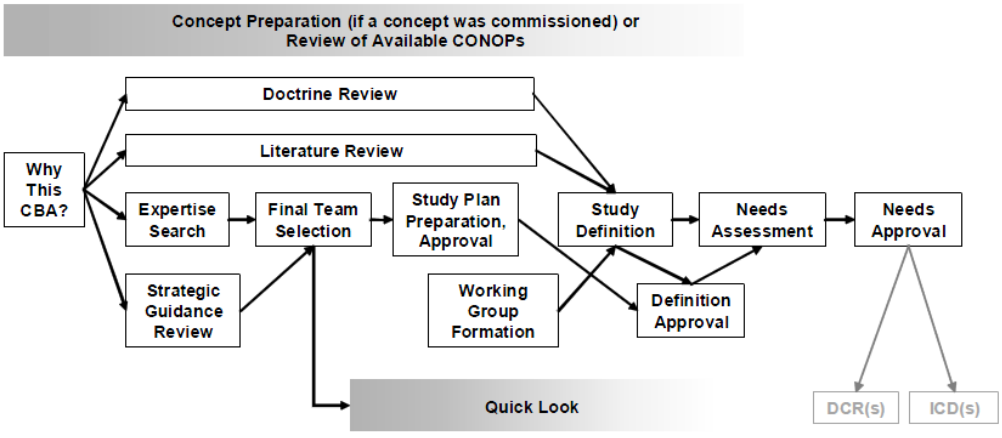

Figure 15. Task Relationships (From Force Structure, Resources, and Assessments Directorate, 2009, p. 25)

Drawing from previous CBA experience, the Team Lead was able to approximate how long each deliverable would take and assigned monthly deadlines to each task. As shown on Figure 16, the Team Lead divided fiscal year 2013 into quarters. Each node on the right-hand side represented a major CBA deliverable. The deliverables were broken down further into monthly tasks and subtasks.

When drafting the schedule, it was important to add "slack" into the schedule for anticipated and unanticipated scheduling delays (Force Structure, Resources, and Assessments Directorate, 2009). Major milestones were not assigned to December, January, and June since the majority of the team would be on vacation during these months. One delay the team did not foresee was the DoD 2013 Sequestration, which required civilian furloughs from July 2013 to August 2013. Consequently, two of the team members were not allowed to work on Fridays. The preplanned slack in the schedule compensated for the furlough and the analysis team completed the CBA on time. As a result, the negative impact of the delays was mitigated.

This chapter discussed analysis team formation, the budget and schedule, and the process used to define the study. The next chapter describes the scenario-based approach used to identify current CCAT capabilities, future capabilities, and capability gaps.

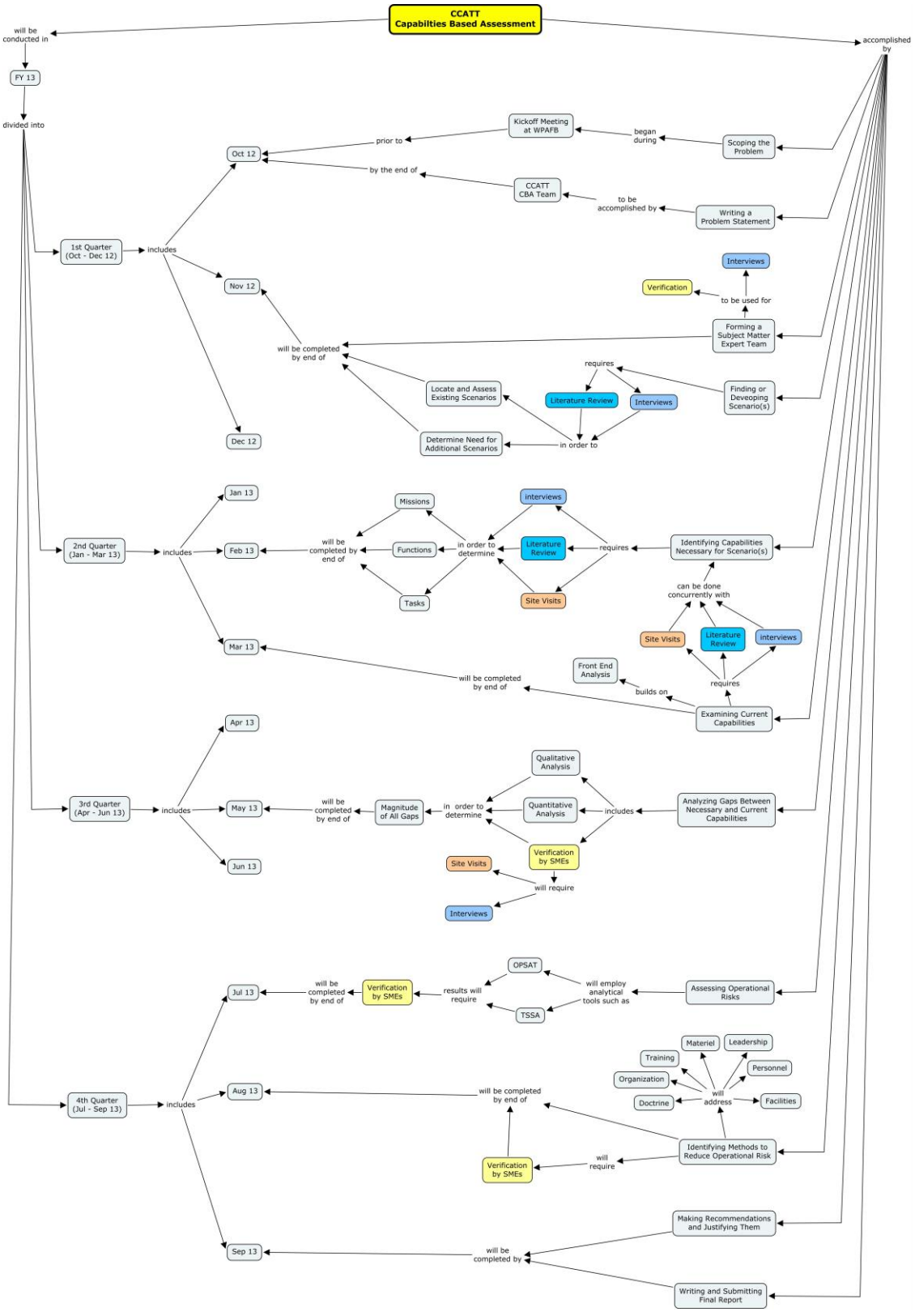

Figure 16. CCAT CBA Timeline

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V. CCAT CAPABILITIES

The purpose of Phases 2 and 3 of the CBA process was to determine the capabilities of the CCAT system and identify capability gaps. Phases 2 and 3 consisted of six steps: examining strategic guidance; conducting a literature review; identifying relevant subject matter expertise; developing future scenarios; collecting data from SME; verifying results; determining current CCAT system capabilities, and identifying CCAT capability gaps.

A. STRATEGIC GUIDANCE

According to the JCIDS Manual, "the mission or military problem considered by the CBA must be relevant to the needs of the defense strategy and other strategic guidance" (Joint Capabilities Integration and Development System, 2012, p. A-B-1). This JCIDS activity required an in-depth review of the U.S. strategic documents including the National Security Strategy (2010), Defense Strategic Guidance (2012), National Military Strategy (2005, 2011), and the Quadrennial Defense Review (2010). Reviewing these documents helped the analysis team identify the nation's strategic objectives, determine the strategic significance of the CCAT mission, and envision the future strategic environment.

1. U.S. Strategic Objectives

In the National Security Strategy, President Obama identified the U.S. national interests as security, prosperity, universal values, and international order (White House, 2010). This document also listed several threats for the 21st century, which included weapons of mass destruction, terrorism, violent extremism, criminal networks, biological attacks, fossil fuel dependence, pandemic disease, climate change, and failing states (White House, 2010). The U.S. strategic approach has relied on the U.S. military to deter, defeat, and defend against these threats (White House, 2010). In order to maintain a quality military that is capable of protecting the U.S. national interest, the National Security Strategy has identified support for the military force as a key strategic objective.

Support for military personnel has been given in a variety of ways including compensation, education, training, incentives, insurance, and health care.

Each of the U.S. strategic documents justified the need for a quality military force by emphasizing the strategic importance of supporting military service members and "enhancing the long-term viability" of the military force (White House, 2010, p. 14). The National Security Strategy supported this claim by stating "the most valuable component of our national defense is the men and women who make up America's all-volunteer force" (White House, 2010, p. 14). The Defense Strategic Guidance described the military personnel as the nation's "most important military advantage" and emphasized the need for a "confident, well-trained, and properly equipped" force (Department of Defense, 2012, p. 7). The Quadrennial Defense Review characterized military service members as the DoD's "most precious military resource," and identified the military's health and warfare as a top strategic priority (Department of Defense, 2010, p. 15). The National Military Strategy recognized military personnel as the nation's "greatest strategic asset" and expressed the need for "to care for Service members and their families" (Chairman of the Joint Chiefs of Staff, 2011, p. 21).

After reviewing the strategic guidance, the analysis team found that medical care for the warfighter is one of the "resources that they need to succeed" (White House, 2010, p. 14). At an operational level, the doctrine set forth in Joint Publication 4-02 Doctrine for Health Service Support in Joint Operations and the FHP concept of operations provided the framework needed to accomplish this strategic objective.

2. Strategic Significance of CCAT

A review of the National Security Strategy, Defense Strategic Guidance, National Military Strategy, and Quadrennial Defense Review revealed the strategic significance of the CCAT system. Supporting the third pillar of the joint FHP mission, the CCAT system has directly supported the military force by providing a continuum of critical care on and off the battlefield. The CCAT system also contributes to the joint FHP mission by "[minimizing] the effects of wounds, injuries, disease, environment, occupational hazards, and psychological stressors on unit effectiveness, readiness, and morale" (Joint

Chiefs of Staff, 2001, p. V). This led the analysis team to believe that CCAT has improved the military force's morale and motivation, resulting in an increase in the overall effectiveness of the U.S. military. Additionally, the CCAT mission has indirectly increased military personnel retention by giving wounded warfighters an "opportunity to return to active duty following their injury" (Department of Defense, 2010, p. xii). The analysis team concluded that the CCAT system supported the nation's strategic objectives; consequently, the CCAT mission was valuable to national security.

3. Projected Strategic Environment

A review of the strategic guidance allowed the team to envision the projected strategic environment and pinpoint the nation's future priorities. The team also consulted the National Intelligence Council's Global Trends 2030 Report (2012) to determine how geopolitical trends could affect the strategic environment and nature of military operations in the next fifteen to twenty years.

The National Security Strategy discussed problems that may be encountered in the future including rising fiscal and trade deficits, constrained fossil fuel, food insecurity, dangers to public health, and economic instability (White House, 2010). According to the Global Trends 2030 Report, the issues identified in the National Security Strategy relate to trends that predict a future with constrained resources. The trends indicated a potential "food, water, energy nexus," which means the supply may not meet the global demand for basic necessities (National Intelligence Council , 2012, p. ii).

Resource constraints will be further exacerbated by an increase in the global population. The Global Trends 2030 Report projected a possible "tectonic shift" in the population's median age, leading to "unprecedented and widespread aging" and more "food and water pressures" (National Intelligence Council , 2012, p. v). The predicted changes in demographic patterns could lead to a decline in economic growth due to a workforce shortage, an increase in migration, and more people living in urbanized areas (National Intelligence Council, 2012).

The social, political, and economical problems associated with these trends threaten international order and U.S. security (Department of Defense, 2008).

Ultimately, these trends could change the role of the U.S. in the global security environment. One possible outcome suggested in the Global Trends 2030 Report is a "diffusion of power," which will eliminate "any hegemonic power" (National Intelligence Council , 2012, p. ii). If this happens, the U.S. will be required to seek assistance from a wide range of global support, diplomacy, and partnerships since the U.S. may not have the resources to maintain global security on its own. The ultimate impact of these trends is a strategic approach that has focused on pursuing comprehensive engagement, which consists of building and improving partnerships between nations, allies, coalitions, international organizations, nongovernmental organizations, and civilian institutions (White House, 2010). According to the National Security Strategy, the military will continue to play an influential role in diplomatic efforts, by "strengthening its capacity to partner with foreign counterparts, train and assist security forces, and pursue military-to-military ties with a broad range of governments" (White House, 2010, p. 11). Furthermore, the National Security Strategy has concentrated on "strengthening national capacity" with a "whole of government approach" (White House, 2010, p. 14). With respect to the military, this approach aims for more integration between the different military branches and better inter-agency coordination (White House, 2010, p. 14).

Furthermore, The Global Trends 2030 Report described climate change as a "black swan," which is an event that could cause "large scale disruption" in the future (National Intelligence Council, 2012, p. iii). Scientific weather data supports this belief, with models projecting an increase in temperature and extreme weather over the next twenty years. Additionally, current prediction methods and models are providing less accurate forecasts due to an increase in the number of anomalous weather events (National Intelligence Council, 2012).

4. The Future of CCAT

The projected global environment and the predictions found in the Global Trends 2030 Report and other strategic guidance could lead to significant changes in the role and mission of CCAT. Therefore, the analysis team used these documents to identify

potential future requirements for the CCAT system and determine whether the current CCAT system would be resilient when faced with these global trends.

In the future, resource constraints may severely hinder CCAT operations. A decrease in military spending could cause a shortage in CCAT personnel. In addition, limited access to fossil fuels may reduce mission range. There is a possibility that the CCAT capability will be diminished or eliminated, which will cause an increase in deaths and suffering on the battlefield. With a projected increase in joint, international, and inter-agency operations, CCAT teams may take on a more diplomatic role. CCAT teams will need to operate on different platforms and diverse environments, and may work with medical personnel from different countries, organizations, and services. Additionally, CCAT teams may be responsible for training and educating their partners.

Furthermore, trends suggest that future operating environments may be more extreme and unpredictable, requiring CCAT personnel to operate under harsher conditions. All in all, the demands of the projected strategic environment could lead to significant decreases in individual and team performance, which could decrease efficiency, mission effectiveness, and total system performance.

B. LITERATURE REVIEW

The analysis team conducted a comprehensive literature review of all the documents listed in Appendix E. Most of the references used during the CCAT CBA came from an electronic library built by the HSI Consultant during the AE/CCAT FEA process. Using this pre-existing library saved the analysis team precious time. The library was downloaded to the Sakai research site, which allowed the analysis team to access all the CCAT-related documents. In order to keep the library organized, the analysis team created an annotated bibliography of all the references.

The literature review provided the analysis team with a top-level understanding of the CCAT terminology, organizational structure, operating procedures, mission requirements, training programs, selection process, doctrine, and policy. The analysis team revised the CCAT CBA concept map as new information was acquired and more relationships were discovered. Upon the completion of the literature review, the Team Lead was confident in the analysis team's knowledge and felt each member was prepared to interact with the SME.

C. SUBJECT MATTER EXPERT SELECTION

It was important that the SME used in the CCAT CBA were representative of the target population and encompassed the appropriate range of expertise. For the CCAT CBA, the analysis team sought four specific SME perspectives. First, the sample of SME needed to represent the total force perspective, which included active duty, reserve, and ANG SME. Second, the analysis team wanted SME who had deployed as CCAT critical care physicians, critical care nurses, and respiratory therapists. Third, it was important to have representation from those organizations and personnel responsible for training and managing CCAT personnel resource. Fourth, the sample needed representation from the strategic, operational, and tactical levels of both the AE and CCAT organization including:

- 445th Unit AFRC;
- Headquarters AFRC;
- Headquarters ANG;
- Headquarters AMC;
- C-STARS;
- Pilot Unit;
- 88th Air Base Wing; and
- USAFSAM.

The CBA User's Guide recommended that analysis teams explore the community and check references to validate whether a particular individual is truly regarded as an expert (Force Structure, Resources, and Assessments Directorate, 2009). Most of the SME invited to participate in the CCAT CBA had already been involved in the AE/CCAT FEA. Selecting the same SME used during the AE/CCAT FEA provided several advantages for the analysis team. First, the analysis team did not have to begin a new search for credible SME since the HSI Consultant was still in contact with many of the AE/CCAT FEA participants. Second, the SME validation process was based on the participant's contributions to the AE/CCAT FEA and the HSI Consultant was able to personally vouch for the selected SME. Third, many of the SME had shown a vested interest during the AE/CCAT FEA and were excited to be a part of the CCAT CBA

effort. All in all, identifying and selecting the relevant expertise was a straightforward and smooth process for the analysis team.

In November 2012, the Team Lead sent the selected SME an email, located in Appendix F, inviting them to participate in the CCAT CBA. Several SME were no longer in the service or had transferred to other positions, but they provided contact information for their replacements. With additional networking by the analysis team, the total number came to thirty SME.

D. ASSUMPTIONS

While conducting the CCAT CBA, the analysis team made several assumptions about the future in which CCAT missions are conducted.

- Unmanned aircraft will not be used for patient transport and the requirement for manned patient transport still exists
- Focus on operations in 2028
- Rebalancing will occur, changing the focus from the East Coast to the West Coast
- The U.S. will not be as forward deployed as currently seen
- A smaller percentage of deployed forces and capabilities will be overseas
- DoD budget will continue to be constrained and will have little to no growth
- Current CCAT medical specialties will still be needed in the future
- Types of patient injuries will expand
- The type of warfare will be asymmetric
- Patients will be military, civilian, neonatal, pediatric, and geriatric
- Medical technology will continue to advance
- Technology will advance but inflight use will lag behind
- Operations will migrate towards Joint and Coalition missions
- Any extended peace will result in degradation of CCAT skills
- Resilience of human systems will not change
- Manpower will not grow over the next 15 years
- Routine care for DoD will transition to civilian medical facilities

E. DEVELOPMENT OF SCENARIOS AND CAPABILITIES

Scenario development was extremely important and the analysis team devoted several months to this activity. After reviewing the strategic documents and literature, the analysis team drafted the first version of four future scenarios. The scenarios were a mechanism used to identify the current capabilities, future capabilities required, and capability gaps during the TIMs. The analysis team first considered using classified Defense Planning Scenarios (DPS), but found it would be difficult because all the SME would need a valid security clearance and working with them would require communications methods and facilities capable of handling classified information. Due to the impracticality of using classified DPS, the team decided to create its own scenarios.

The JCIDS Manual required the scenarios to encompass "the breadth of the strategic environment" (Joint Capabilities Integration and Development System, 2012, p. A-B-1). The analysis team fulfilled this requirement by basing the framework for the CCAT CBA scenarios on the strategic guidance. In particular, each of the scenarios addressed one of the four security challenge categories listed in the National Defense Strategy (2005), described as traditional, irregular, disruptive, and catastrophic (Rumsfeld, 2005). Additionally, each scenario was modeled in accordance with the strategic environment envisioned by the strategic documents and Global Trends 2030 Report.

After conducting the literature review and drafting the scenarios, the analysis team created a preliminary list of over-arching capabilities needed for CCAT missions. Before the capabilities were identified, the analysis team first determined what the nature of the scenario was by describing the threat, CCAT relevance, overarching objective, and subordinate objectives. Once these elements were identified, the analysis team listed the overarching and subordinate capabilities needed to execute a CCAT mission in the given scenario. A spreadsheet of this preliminary analysis was developed for presentation of the February 2013 TIM and a portion of this analysis is located in Appendix G.

F. FEBRUARY 2013 TECHNICAL INTERCHANGE MEETING (TIM 1)

In February 2013, the analysis team conducted the first TIM. The purpose of the TIM 1 was to introduce SME to the analysis team, explain the purpose of the CBA, improve the future scenarios, and expand the first draft of the HTA.

1. Planning TIM 1

Planning for TIM 1 took several weeks. The first TIM was held at WPAFB at the Tec Edge facility and an invitation to TIM 1 was sent to the SME in January 2013. The analysis team was concerned about SME attendance at the TIM due to the travel restrictions and funding cuts for DoD personnel. Most SME were only allowed to travel if it was mission essential. Fortunately, many SME lived close to WPAFB and were able to travel to the TIM at their own expense. The team developed a backup plan using video teleconferencing capabilities for SME who were not able to attend. Other preparation efforts included setting up catering, ordering supplies, printing TIM 1 worksheets, and compiling the folders for each SME. The contents of the folders consisted of the TIM 1 Agenda, SME consent form, definitions document, scenarios document, and capabilities spreadsheet.

2. Attendance

Those attending TIM 1 were the entire analysis team, eighteen SME, and two HSI practitioners from 711th HPW/HP. As shown on Table 6, all CCAT organizations had at least one representative at TIM 1.

Table 6. Attendance for CCAT CBA February 2013 TIM

#	Rank	Organization
1	O-6	Headquarters AFRC
2	O-6	445th AFRC
3	O-5	AMC
4	O-5	Headquarters ANG
5	O-6	Headquarters ANG
6	E-7	Headquarters ANG
7	O-6	88th Air Base Wing
8	O-4	59th Medical Wing Pilot Unit
9	O-5	C-STARS Cincinnati (USAFSAM)
10	O-5	C-STARS Cincinnati (USAFSAM)
11	O-5	C-STARS Cincinnati (USAFSAM)
12	O-4	C-STARS Cincinnati (USAFSAM)
13	E-7	USAFSAM
14	O-4	USAFSAM
15	O-3	USAFSAM
16	O-6	USAFSAM
17	O-4	711th HPW/XPH
18	O-5	AFMSA

3. Activities

Before TIM 1 started, each SME was asked to sign a consent form and given a folder containing handouts. The consent form is located in Appendix H. TIM 1 started with formal introductions of the analysis team and SME. The format of the TIM 1 was similar to that of a focus group where participants were encouraged to speak freely. After formal introductions, the Team Lead gave a presentation that provided an overview of the CBA process, defined HSI, discussed how HSI is used during the CCAT CBA, summarized the AE/CCAT FEA findings, and showed the first draft of the CBA.

After the presentation, the Team Lead discussed each handout. The first handout was the TIM agenda. The second handout, found in Appendix I, consisted of several terms commonly used during the CBA process. Since there were many ways to define these terms, it was important for the analysis team to standardize the definitions to create a common baseline for all SME. The Team Lead explained each definition, but

emphasized the term "capability." As stated in the CBA User's Guide, a CBA should "[describe] needs in terms of capabilities, instead of systems of force elements" (Force Structure, Resources, and Assessments Directorate, 2009, p. 5). Therefore, Team Lead emphasized that the SME should not focus specific solutions, but suggested the SME use the phrase "the ability to" to avoid arriving at solutions prematurely.

The third handout, found in Appendix J, was a summary of the key U.S. strategic documents. The analysis team used this handout to help describe the projected strategic environment, and discussed possible geopolitical challenges the CCAT system could face during the next fifteen to twenty years. The purpose of this discussion was to encourage the SME to consider how these global trends could impact the CCAT mission. The fourth handout was the spreadsheet listing the preliminary capabilities. The SME were encouraged to expand on them. The fifth handout, found in Appendix K, was a data collection sheet with the first draft of the concept map.

After reviewing the handouts, the Team Lead discussed the four scenarios. Using a talk-through approach, the Team Lead asked the SME to explain each step needed to conduct a CCAT mission during the irregular scenario. The Team Lead documented the steps and the required capabilities on the white board. The analysis team used this technique during TIM 1 for the remaining three scenarios. Afterward, two SME who were not able to attend in person recommended additional capabilities not mentioned during the TIM.

4. Site Visit

After the first TIM, the analysis team toured two CCAT training facilities. The first visit was to the C-STARS training facility located in Cincinnati, Ohio. The main purpose of the C-STARS training program is to ensure the CCAT members are properly trained prior to deployment. The analysis team interviewed several members of the training staff and were given access to the CCAT equipment. Then the analysis team observed a simulator training sortie with a newly-formed CCAT team and saw how CCAT teams are graded during the validation process.

The second tour took place at the USAFSAM training facility at WPAFB in Dayton, Ohio. The purpose of the basic course is to provide CCAT personnel with initial training. The analysis team saw the training simulator used for CCAT basic training. The purpose of the basic course is to provide CCAT personnel with initial training. Both site visits provided the analysis team with great insight into CCAT training, validation requirements, CCAT member interaction, and the teamwork required to conduct the mission.

5. TIM 1 Notes

After the site visits, the HSI Consultant drafted a report that summarized the progress. The notes, located in Appendix L, were sent to the sponsors to update them on the CCAT CBA progress.

G. SUMMARIZING THE RESULTS THROUGH TIM 1

Upon completion of the first TIM, a needs analysis consolidated and examined the potential issues by comparing the future needs to the capabilities of the current system. The results from the literature review, first TIM, and the site visit, were summarized based on the nine USAF HSI domains.

1. Manpower

With a rise in the number of CCAT missions, there may not be enough CCAT personnel to keep up with the operational demands. The operational tempo of CCAT missions could increase in the future, which may require more CCAT personnel.

2. Personnel

Selecting personnel for the CCAT mission has been difficult, which further contributes to the manpower deficiency. This personnel selection issue must be resolved to ensure manpower can meet the operational needs of the future.

3. Training

The AE/CCAT FEA found that 11% of the AOI dealt with training (Graddy, Cooks, & Cosing, 2012). Training is essential, and if it is not being conducted properly, it will negatively impact CCAT performance and future operations. During the first TIM and site visit, it was apparent that teamwork was an extremely important skill for successful CCAT operations. While teamwork skills were being evaluated during the C-STARS course, more emphasis may be needed on this part of the curriculum.

4. Human Factors Engineering

The AE/CCAT FEA determined that 14% of the AOI involved equipment (Graddy, Cooks, & Cosing, 2012). The CCAT equipment is heavy, but fragile, and is now loaded and unloaded by hand. Equipment issues would need to be further investigated to determine if redesign could reduce these negative aspects of the current CCAT equipment.

5. Safety

Lack of sleep, long operating hours, no limit on crew day, no crew rest, reduced manpower, high workload, intense environmental stressors, fluctuations in circadian rhythm, fatigue, jet lag, and time pressure are a few of the factors that impact CCAT safety, health, and performance. Unsafe, unhealthy, uncomfortable, and unsatisfactory working conditions are "sources of psychological stress, and so they may have harmful physiological and psychological consequences" (Proctor & Van Zandt, 2008, p. 467). These consequences can cause fatigue, discomfort, sickness, injury, and poor performance, loss of situational awareness, reduced attention, and confusion. Furthermore, "extremely high stress can severely impair a person's ability to make decisions, particularly if the person feels that he or she is under time pressure (Proctor & Van Zandt, 2008, p. 492). Ultimately, all of these issues influence performance of CCAT personnel.

6. Occupational Health

Injuries to CCAT personnel are on the rise. Many of these injuries are caused by lifting heavy loads of equipment and patients. If these injuries continue, mission completion rates will suffer because CCAT personnel will not fully capable.

7. Environment

An aircraft at altitude is not an ideal environment for performing medical procedures on the critically sick and wounded. Lighting, ventilation, cleanliness, temperature, cabin pressure, noise, and motion are only a few of the factors that CCAT members and patients must face. If the human component of the system is not performing optimally, system performance and effectiveness will decrease (Proctor & Van Zandt, 2008). Physical characteristics of the operational environment often contribute to a decline in human performance. Exposure to extreme temperatures, harsh climates, severe weather, poor air quality, rugged topography, rough seas, and restricted visibility are all environmental factors that affect human performance. For CCAT members, noise, vibration, temperature, lighting, motion, air quality, sanitation, dehydration, nutrition, fatigue, and post-traumatic stress disorder (PTSD) can all have a dramatic effect on the health, combat effectiveness, safety, and morale of CCAT personnel.

8. Habitability

CCAT missions are usually several hours in length. Therefore, habitability issues on the aircraft are extremely important and can significantly impact human performance.

9. Survivability

Most CCAT missions are conducted in operational theaters; therefore, the CCAT members and patients may be vulnerable to enemy attack. As enemy technology and tactics evolve, additional survivability measures may be required to protect CCAT members and patients.

H. CONDITIONS

The analysis team identified several recurring issues that were brought up during the AE/CCAT FEA, the literature review, and the TIM. The recurring issues became the conditions used to refine the future scenarios. These include:

- Fatigue
- Crew Resource Management
- Burnout
- PTSD
- Adrenaline Junkies
- Resilience
- Logistics of CCAT Equipment
- Communication Flow of equipment purchasing
- Communication flow between CCAT team, AE personnel, those on the ground, and the hospital
- Training
- Team Formulation
- Tracking of personnel

I. SCENARIO MODIFICATIONS

Between March and June 2013, the team took the issues collected from TIM 1 and site visit, and modified the future scenarios. The first modification to the scenarios involved taking a more narrative approach, which included some creative writing and development of fictional characters and locations. This approach was taken because using actual locations could have raised some security concerns. The second modification was to make the scenarios more relevant to the CCAT team member roles by adding more specific details about the individuals into each scenario. Each critical care physician, critical care nurse, and respiratory technician in the future scenarios had different levels of experience, rank, knowledge, skills, and abilities.

The third modification was to highlight the specific recurring issues found after the analysis of the TIM 1 results. This technique ensured that the problematic issues were included in the storyline of the scenario. With this change, the future scenarios

provided “the full spectrum of operational situations relevant to the defense strategy” because each one focused on specific reccurring issues identified during the AE/CCAT FEA, CCAT CBA literature review, and TIM 1 (Joint Capabilities Integration and Development System, 2012, p. A-B-1). The revised scenarios expanded upon the standard mission by incorporating different human-centric challenges in a variety operating conditions to help expose capability gaps. The revised scenarios were validated by two SME prior to the second TIM during a teleconference. The SME corrected several minor issues.

J. HIERARCHICAL TASK ANALYSIS

Between March and June 2013, the analysis team used a combination of top-down and bottom-up approaches to identify capabilities, functions, and task. The team restructured the capabilities spreadsheet by constructing a HTA using the IHMC CmapTool software. The HTA concept map was used during the second TIM.

K. JUNE 2013 TECHNICAL INTERCHANGE MEETING (TIM 2)

In June 2013, the analysis team conducted the second TIM. The purpose of TIM 2 was to validate and verify the future scenarios and the revised HTA. Additionally, the analysis team conducted a preliminary gap analysis, which began the needs assessment portion of the CBA process.

1. Planning

The planning for the second TIM was similar to the planning for the first TIM. In May 2013, email invitations for the second TIM were sent to the SME. The HTA with the capabilities, functions, and tasks were printed on large posters, which made it easier to present to the SME.

2. Attendance

Those attending TIM 2 were the entire analysis team, eleven SME, four HSI practitioners from 711th HPW/HP, and one researcher from USAFSAM. As shown in Table 7, six out of the eight organizations had at least one representative at the TIM.

Table 7. Attendance for CCAT CBA June 2013 TIM

#	Rank	Organization
1	O-5	AMC
2	O-5	AMC
3	O-5	Headquarters ANG
4	O-5	C-STARS Cincinnati (USAFSAM)
5	O-5	C-STARS Cincinnati (USAFSAM)
6	E-6	USAFSAM
7	O-5	USAFSAM
8	O-3	USAFSAM
9	O-4	711th HPW/XPH
10	O-3	711th HPW/XPH
11	O-5	AFMSA

3. Activities

Before the TIM started, any new TIM participants signed the consent form and formal introductions were made. The first day of the TIM was dedicated to verification and validation of the future scenarios. The analysis team split the SME into two groups so that each group had roughly the same composition to balance the different perspectives. Recommendations for future scenario improvement included adding a timeline to each of the scenarios.

On the second day of the TIM, the focus was on finishing the talk-through of each capability and conducting a preliminary gap analysis. Referring back to the future scenarios, the Team Lead asked the SME to evaluate the current CCAT system to determine whether it was capable of accomplishing the conditions found in each future scenario. Using the scale presented in Figure 17, the Team Lead asked the SME to estimate the size of the gap on a scale from 0 to 5 with 0 signifying no gap and 5 signifying a large gap. Preliminary gap analysis is located in Appendix M.

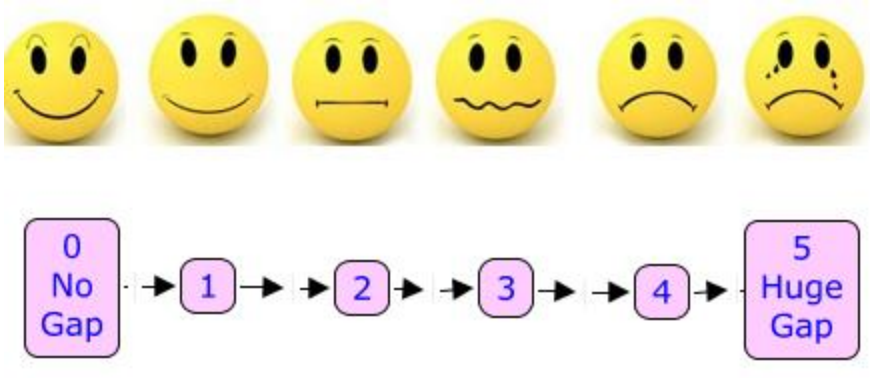

Figure 17. Scale of Preliminary Gap Analysis

The efforts of the TIM 2 SME were validated by four additional SME who were not able to attend in person. Over the phone, the analysis team described what had happened during TIM 2 and these additional SME recommended additional capabilities that were missing from the list.

4. TIM 2 NOTES

Upon completion of TIM 2, the HSI Consultant drafted a report that summarized the TIM. The notes are located in Appendix N. The entire analysis team had the opportunity to debrief the 711th HPW/HP Director about the CCAT CBA progress.

L. FINALIZED PHASE 2 AND 3 PRODUCTS

After the second TIM, the analysis team finalized the future scenarios (see Appendix O). The final HTA consisted of 8 capabilities, 35 functions, and 183 tasks associated with the CCAT system. The analysis team revised the HTA concept map (see Appendix P). Table 8 provides an example of the capabilities, function, and task listing. Appendix Q contains the full listing.

This chapter explained how the strategic guidance, literature review, and assumptions were used to develop four future scenarios. The scenarios helped SME identify the CCAT system capabilities, as well as capability gaps. The next chapter explains how the analysis team prioritized the capability gaps.

Table 8. Sample of Finalized HTA

Capability 1: Prepare for CCAT Operation			
Func #	**Function**	**Task #**	**Task**
1.1	Manage Recall Rosters	1.1.1	Updating recall roster at higher levels (HQ)
		1.1.2	Creating recall roster at higher levels (HQ)
		1.1.3	Updating recall roster at MTF (rosters updated monthly)
		1.1.4	Creating recall roster at MTF (rosters updated monthly)
1.2	Prepare for mission	1.2.1	Draw blood and blood products (contingency ops)
		1.2.2	Draw medications
		1.2.3	Collecting all necessary equipment for CCAT operations from staging area
		1.2.4	Loading equipment on platform (need CONOPS)
		1.2.5	Checking equipment for serviceability
		1.2.6	Coordinating with crew to configure non-standard platform
		1.2.7	Coordinating with crew to configure standard platform
		1.2.8	Inventorying equipment
		1.2.9	Transport team/equipment from MTF to airfield
1.3	Receive mission information	1.3.1	Receiving situational information (tactical updates)
		1.3.2	Receiving accurate information concerning patient acuity
		1.3.3	Conducting CCAT operational pre-planning activities
		1.3.4	Ensuring personnel have applicable VISAs and documentation to allow for entry into different countries
1.4	Select CCAT personnel based on operational requirements (administrative preparation for CCAT activation)	1.4.1	Determine position and qualifications needed for operation
		1.4.2	Identify eligible CCAT Personnel
		1.4.3	Notify selected CCAT personnel
		1.4.4	Select CCAT personnel for mission

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VI. RISK ASSESSMENT

The purpose of Phase 4 of the CBA process was to conduct an assessment of "the potential operational risk associated with each capability gap" (Joint Capabilities Integration and Development System, 2012, p. A-B-4). Risk assessments are typically conducted at the capability level, but the analysis team decided to do it at the task level to avoid missing highly rated tasks embedded in less important capabilities. The CCAT CBA risk assessment provided a subjective measure that was used to prioritize the gaps and helped the analysis team determine which gaps needed to be filled. The analysis team modeled the CCAT CBA risk assessment after the Risk Management Guide for DoD Acquisitions (2006).

A. DEFINITIONS

Risk contains three components: a future root cause, likelihood of occurrence, and consequence of occurrence (Department of Defense , 2006). The definitions for the risk assessment portion of the CCAT CBA can be found in Table 9.

Table 9. Risk Assessment Definitions

Term	Definition	Scale Range	Scale Definition
Likelihood	The probability that the task or function will not happen	0.0 - 1.0	A rating of 0.0 means the function or task is likely to happen
			A rating of 1.0 means the function or task is nearly certain to not happen
Severity	The consequence or impact on the CCAT mission if the task or function does not happen.	0.0 - 10.0	A rating of 0.0 means the consequence is low
			A rating of 10.0 means the consequence is high

B. PRELIMINARY RISK RATINGS

Based on the data gathered from Phases 2 and 3 of the CBA process, the entire analysis team conducted a preliminary risk assessment which consisted of rating the severity and probability of the 183 individual tasks. The analysis team then contacted the

SME to verify the preliminary ratings. Due to the sheer volume of tasks, the analysis team decided that it was too much work for each SME to rate every task. The analysis team was concerned that rating all 183 tasks would overburden the SME, which could affect the quality and accuracy of the ratings. Therefore, the analysis team reduced the workload by dividing up the tasks amongst the SME. The HSI Consultant assigned the tasks to the SME so that there was representation from all organizations (active duty, reserve, ANG) and positions (physician, nurse, and respiratory therapist).

In July 2013, detailed instructions were sent to each SME explaining the verification process. The SME were encouraged to change the analysis team's preliminary ratings if they did not agree with them. As part of the validation process, the analysis team contacted the SME via telephone or email to discuss the rationale behind their changes.

The verification and validation process would have been easier to do face-to-face; however, the schedule and budget did not allow for another TIM. Unfortunately, the responses were slow and many of the SME were unable to participate in this portion of the CBA process due to other commitments. In the end, at least two SME verified 181 individual tasks while 66 of the tasks were verified by three SME.

C. RISK ANALYSIS

The analysis team used multiple methods to analyze the data, including a rating comparison, rankings, and visual approach.

1. Comparison of Ratings

The analysis team compared their preliminary ratings against the ratings of each of the SME. Only 24.3% of the preliminary ratings were changed by the SME. Specifically, 22 likelihood ratings and 67 severity ratings were changed. On average, the analysis team's preliminary ratings differed from the SME ratings by 0.18 for likelihood (SD = 0.08) and 0.34 for severity (SD = 0.70). The comparison of the team's ratings against those of the SME can be found in Appendix R.

2. Rankings

The analysis team used a three-step process to rank the 183 tasks. In the first step, the analysis team ranked the SME average likelihood ratings. In the second step, the analysis team ranked the average of the SME severity ratings. In the third step, the analysis team multiplied each task's average likelihood rating by the average severity rating. This risk rating was then used to rank all 183 tasks. The rankings were 1 to 178 once the ties were addressed. This overall ranking allowed the analysis team to prioritize the tasks based on those that presented the most risk to accomplishing the CCAT mission. These rankings are listed in Appendix S.

3. Visual Approach

The analysis team used a visual approach to illustrate the rankings by constructing a risk matrix (see Appendix T) modeled after the Risk Management Guidebook (2006). A sample of this matrix is shown in Figure 18. In the risk matrix, the average likelihood rating for each task was plotted against the average severity rating for each task. The Team Lead separated the risk matrix into three sections to signify the amount of risk for each task. The red section indicated tasks with high risk; the amber section indicated tasks with medium risk, and the green section indicated tasks with low risk. After plotting each task, thirty tasks fell within the high risk section. The analysis team considered all tasks within the red section to see how they contributed to the capability gaps. These tasks are those which have the highest priority for mitigation by a material or non-material solution to move the risk category from unacceptable to moderate or low. In addition, the team analyzed the tasks that had extremely high severity but low likelihood ratings. Using the risk matrix, the analysis team isolated nine tasks with severity ratings above 0.85. On the opposite end of the risk matrix, the analysis team did not identify any low severity tasks with high likelihood ratings since all were below a likelihood rating of 0.8. The team prioritized the gaps using the overall rankings and the risk matrix. Since the schedule did not allow the team to make recommendations for all 183 tasks, the analysis team focused on the tasks with the most risky and severe gaps.

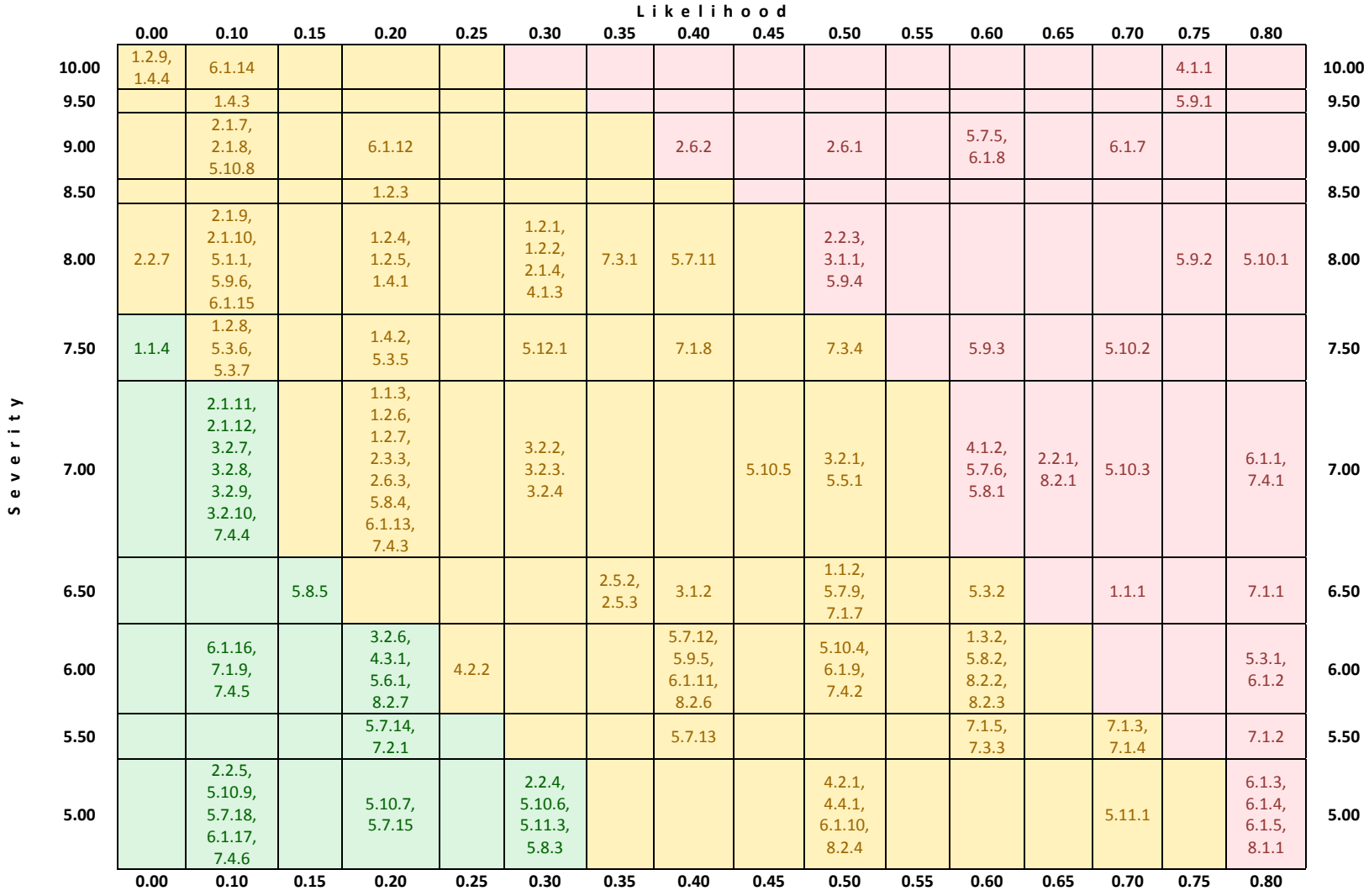

Figure 18. Sample of CCAT CBA Risk Matrix

D. FINAL PHASE 4 PRODUCTS

Upon conclusion of the risk assessment, the analysis team identified 32 tasks with the most risk (those tasks in the red section of the matrix) and the highest ranked tasks, as well as the top nine most severe tasks. All in all, the team identified 41 gaps that Phase 5 would address. These task-level gaps are listed in Table 10. The next chapter presents the HSI domains and DOTmLPF-P recommendations to fill the capability gaps.

Table 10. Task-level Gaps

#	Overall Ranking	Risk	Task #	Task
1	1	High	4.1.1	Maintain critical care proficiency
2	2	High	5.9.1	Select suitable CCAT physician
3	3	High	5.10.1	Provide appropriate manpower
4	4	High	6.1.7	CCAT representation in acquisition process
5	5	High	5.9.2	Select suitable CCAT respiratory therapist
6	6	High	6.1.1	Determine requirements
7	6	High	7.4.1	Determine requirements
8	8	High	5.7.5	Create curriculum to facilitate the effects of altitude on patient outcome
9	8	High	6.1.8	Equipment to monitor patient status locally
10	10	High	7.1.1	Establish policy/standards for CCAT international operations
11	11	High	5.10.2	Provide the same equipment (technology) as that used during CCAT operations at home station
12	12	High	5.10.3	Provide appropriately experienced and qualified instructors
13	13	High	5.3.1	Conduct CCAT task analysis
14	13	High	6.1.2	Equipment to store perishable items (contingency ops)
15	15	High	1.1.1	Updating recall roster at higher levels (HQ)
16	15	High	2.2.1	Providing ability to communicate with non-English speaking personnel
17	15	High	8.2.1	Strategic CONOPS
18	18	High	2.6.1	Safely load and offload patients into non-standard platform (personnel focus)
19	19	High	5.9.3	Select suitable CCAT nurse
20	20	High	7.1.2	Establish DoD and international standards for

#	Overall Ranking	Risk	Task #	Task
				development/procurement of medical equipment
21	21	Mod	5.3.2	Identify best practices
22	22	High	4.1.2	Maintain the ability to operate equipment that is not commonly used in the MTF setting
23	22	High	5.7.6	Create curriculum to facilitate fatigue management appropriately
24	22	High	5.8.1	Evaluate trainers and instructors
25	25	High	2.2.3	Strategic communication
26	25	High	3.1.1	Provide personnel resilience
27	25	High	5.9.4	Evaluate eligible CCAT personnel
28	25	High	6.1.3	Equipment to monitor patient status remotely
29	25	High	6.1.4	Equipment to document patient care information (electronically)
30	25	High	6.1.5	Equipment to transfer patient care information (electronically)
31	25	High	8.1.1	Generate and/or update database of platform information
32	37	High	2.6.1	Safely load and offload patients into non-standard platform (personnel focus)
33	92	Mod	6.1.12	Equipment to alert CCAT personnel of patient status changes
34	95	Mod	1.2.3	Collecting all necessary equipment for CCAT operations from staging area
35	130	Mod	6.1.14	Equipment to provide O2 en route
36	134	Mod	1.4.3	Notify selected CCAT personnel
37	135	Mod	2.1.7	Care to critical pediatric patients
38	135	Mod	2.1.8	Care to critical neonatal patients
39	135	Mod	5.10.8	Provide the same equipment (technology) as that used during CCAT operations at formal training
40	178	Mod	1.4.4	Select CCAT personnel for mission
41	178	Mod	1.2.9	Transport team/equipment from MTF to airfield

VII. CCAT CBA RECOMMENDATIONS

Phase 5 of the CCAT CBA process was to devise recommendations to fill the gaps found in Phase 4. Recommendations are generally formulated to close capability gaps, but since the risk assessment focused on tasks, the analysis team concluded that it was more effective to make recommendations at the task level rather than recommendations for capabilities. Although this approach deviated from CBA guidance, the analysis team determined it was important to do so to meet the sponsors' expectations of delivering actionable recommendations.

A. CATEGORIES OF RECOMMENDATIONS

According to the CBA User's Guide, the recommendations do not have to be "a detailed solution analysis" and should "provide advice on the form of the solution" (Force Structure, Resources, and Assessments Directorate, 2009, p. 58). The analysis team used the DOTmLPF-P and nine USAF HSI domains as the framework for generating the recommendations. Since training and personnel are found in both the list of HSI domains and DOTmLPF-P, the combined framework included 15 categories: Doctrine; Organization; Training; Materiel; Leadership and Education; Personnel; Facilities; Policy; Manpower; Human Factors Engineering; Safety; Occupational Health; Environment; Habitability; and Survivability.

B. RECOMMENDATION MATRIX

Formulating recommendations for 41 gaps was an arduous task, especially when there were 15 different categories to consider for each gap. The analysis team constructed a matrix to organize and track the recommendations. The matrix establishes the foundation for future trade-off analyses. As shown in Table 11, the training (32 recommendations) and policy (28 recommendations) categories were found to offer the most possibilities for closing gaps.

Table 11. Recommendation Matrix

Task #	Manpower	Personnel	Training	HFE	Safety	OH	Environment	Habitability	Survivability	Doctrine	Organization	Materiel	Leadership & Education	Facility	Policy
4.1.1		X	X							X	X				X
5.9.1		X	X												X
5.10.1	X	X	X								X				X
6.1.7	X	X	X								X				X
5.9.2		X	X												X
6.1.1	X	X	X								X				X
7.4.1	X	X	X								X				X
5.7.5			X	X	X	X		X	X			X			
6.1.8			X	X								X			
7.1.1	X		X	X	X			X		X	X		X		X
5.10.2			X									X			X
5.10.3	X	X	X								X		X		
5.3.1	X	X	X	X	X	X	X	X			X	X			
6.1.2				X								X			
1.1.1				X								X	X		X
2.2.1	X	X	X												X
8.2.1	X	X								X	X				
2.6.1			X	X	X	X						X	X		X
5.9.3		X	X												X
7.1.2				X	X					X	X	X		X	X
5.3.2										X					X
4.1.2		X	X												X
5.7.6		X	X		X	X	X								X
5.8.1	X	X	X										X		X
2.2.3											X		X		X
3.1.1			X			X			X						
5.9.4		X													X
6.1.3				X								X			
6.1.4			X	X			X								X
6.1.5			X	X			X								X
8.1.1			X	X	X	X	X	X	X	X		X	X		X

Task #	Manpower	Personnel	Training	HFE	Safety	OH	Environment	Habitability	Survivability	Doctrine	Organization	Materiel	Leadership & Education	Facility	Policy
2.6.2			X	X	X	X						X	X		
6.1.12			X	X	X		X					X			X
1.2.3			X	X	X										
6.1.14			X	X	X		X					X			
1.4.3	X	X	X												
2.1.7	X	X	X		X										X
2.1.8	X	X	X		X										X
5.10.8			X	X	X		X					X		X	X
1.2.9	X	X	X	X	X							X			
1.4.4	X	X			X		X								X
TOTAL	15	21	32	18	16	7	9	4	3	6	11	15	8	2	28

C. TASK-LEVEL RECOMMENDATIONS

After completing the recommendation matrix, the analysis team formulated 195 specific recommendations to close task-level gaps for all of the 41 tasks identified during the risk assessment. The prioritized task-level recommendations can be found in Appendix U. The analysis then synthesized the specific recommendations into high-level recommendations. The 14 high-level recommendations are presented below.

1. Manpower Recommendation

The USAF needs to conduct a detailed manpower study and task analysis that addresses all aspects of the CCAT mission for standard, surge, and international operations. From this manpower study, manning requirements should be derived that will address CCAT team membership, CCAT instructors, and all needed support personnel for active duty, reserves, and ANG.

2. Personnel Recommendation

The USAF needs to conduct a detailed task and job analysis that focuses on the personnel selection and retention processes of CCAT. Personnel selection should include criteria that address each of the team member roles; CCAT acquisition professionals; CCAT instructors; and evaluators of CCAT instructors. A tracking system should be created to follow CCAT members throughout their careers, allowing for visibility, availability, currency, proficiency, and quick recall.

3. Training Recommendation

The USAF needs to conduct a training needs analysis that is embedded in the overall CCAT task and job analysis effort. This analysis will result in a training plan to determine what kind of training, how often it should occur, how it should be conducted, who should deliver it, and a method for assessing the effectiveness of the training. It should address the standard, surge, and international CCAT operations. The training analysis should address all aspects of the CCAT mission to include safely operating all equipment, systems, and the clinical skills necessary to provide CCAT care for

conventional military patients, as well as geriatric, pediatric, and neonatal populations. There needs to be CCAT representation in the acquisition process. The skills needed are CCAT, acquisition, and HSI.

4. Human Factors Engineering Recommendation

The USAF needs to develop equipment that takes into consideration the many human interactions with the system. The equipment development should focus on monitoring patient status in adverse environments; storing and administering perishable items; conducting operations in an efficient and safe manner; the communication of patient status and information in an efficient manner by all participants in the mission, and equipment that is standardized across the spectrum of operations, participants, platforms, and levels of care.

5. Safety and Occupational Health Recommendation

The USAF needs to focus on safety and occupational health concerns and incorporate mitigation techniques in all aspects of the CCAT mission. Safety and Occupational Health impacts mission accomplishment and requires personnel be trained and educated on: the impacts of altitude and fatigue on patients and personnel; on the proper way to lift, carry, and transport heavy objects; and standards that define Safety and Occupational Health considerations. Equipment should be designed and developed that will support safe operations and minimize negative impacts on personnel and patients. In addition, methods need to be developed to increase personnel resilience. Understanding the impact of repetitive missions in a war zone with little recovery time will facilitate training and policy changes that improve personnel resilience and reduce the effects of compassion fatigue.

6. Environment Recommendation

The USAF needs to understand the current and predict the future environments in which CCAT will operate. The USAF should focus on understanding the current environments. Examples of these environments include but are not limited to the effects of fatigue on personnel; how noise impacts patient monitoring; and how altitude affects patient physiology. While gaining an understanding of current environments, the USAF

should analyze where future missions may occur. Gaining insight into the future environments will enable development of equipment, personnel, and curriculum to combat the environmental impacts on the mission.

7. Habitability Recommendation

The USAF needs to develop equipment and policy that limit duration and impact of operating environment on personnel performance. Understanding the inefficiencies caused by habitability constraints will enable personnel overcome the constraints and improve performance.

8. Survivability Recommendation

Survivability is meant to address the items listed in the definition, and was considered beyond the scope of this CCAT CBA. Survivability needs to be addressed on each specific platform being utilized.

9. Doctrine Recommendation

The USAF needs to review and revise the current doctrine to ensure doctrine provides appropriate guidance for evolution of CCAT equipment and procedures in the future: Some focus areas concern: training and procedures; the joint and international medical and operational communities' ability and requirement to train together; joint and international standards for equipment development/procurement; and platform information to enable mission transition to non-standard platforms.

10. Organization Recommendation

The USAF needs to address the manner in which CCAT personnel and equipment are matrixed across the organization and components. The matrixing can often lead to inefficiency and frustration. These need to be minimized through innovative design of the organization and organizational chains of command and communication.

11. Materiel Recommendation

The USAF needs to ensure CCAT personnel are involved in the design, acquisition, testing, and certification of all CCAT-related equipment. Also, it needs to

streamline the process of equipment acquisition regardless of whether it is designed or commercial-off-the-shelf. Specific items to consider are: monitoring of patients both locally and remotely; storing of perishable items during contingency operations; communication with the MTF; materiel that transports patients, team, and equipment from the MTF to on/off-loading of all items to the platform; and the procurement of equipment that is the same as in the field for training programs.

12. Leadership and Education Recommendation

The USAF needs to provide resources to improve leadership skills and education in the following areas: international processes and operations; medical best practices; management/communication best practices; and crew resource management.

13. Facility Recommendation

The USAF needs to identify the current real property being utilized for CCAT training, testing, and storage of personnel and equipment and determine if those resources are sufficient for current and future operations.

14. Policy Recommendation

The USAF should analyze the DoD, inter-agency or international policies that may prevent the effective implementation of the recommendations presented in the previous sections. If the analysis identifies policy issues or lack of policy to support the needed recommendations, the USAF should modify or create policy to support the implementation of recommendations.

D. DEBRIEF TO SPONSORS

In September 2013, the analysis team returned to WPAFB to debrief the sponsors and CCAT leadership on the CBA methodology and recommendations. It was important to have the CCAT leadership at the meeting because it provided an opportunity to socialize the recommendations. The final CBA report was completed on September 30, 2013. The next chapter summarizes the CCAT CBA process, provides lessons learned, and recommendations for future research.

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VIII. CONCLUSION AND RECOMMENDATIONS

A. SUMMARY

The analysis team conducted a year-long, five-phased HSI-focused CBA. During Phase 1 of the CBA process, the analysis team determined the scope of the CCAT CBA and wrote the study problem statement. In Phases 2 and 3, the analysis team created scenarios and conducted an HTA, which were tools used to solicit subjective data from SME during two TIMs. Upon conclusion of Phase 3, the analysis team identified eight capabilities, 35 functions, and 183 tasks comprising the CCAT mission. Phase 4 of the project consisted of a risk assessment to determine and prioritize the 41 highest risk task-level gaps. During Phase 5, the analysis team created a recommendation matrix which was used to organize the DOTmLPF-P and nine USAF HSI domain solutions. The analysis team developed 195 specific task-level recommendations, and provided the sponsors with 14 high-level recommendations.

This thesis demonstrated how a CBA can be conducted from an HSI perspective and illustrated how the analysis team used HSI TTAMs throughout the process. This thesis discussed how the analysis team tailored the CBA process to fit the HSI framework within the boundaries of CBA doctrine and guidance. Additionally, this thesis demonstrates the value of incorporating HSI early in a system life-cycle. Using an HSI perspective provides solutions that are less expensive and faster to implement, since many of them are non-materiel and do not have to go through the entire acquisition process.

B. LESSONS LEARNED

The success of the CCAT CBA was largely due to the analysis team members' expertise as HSI practitioners and their ability to work with a diverse group of stakeholders. A key lesson learned was that an HSI practitioner must be able to assume many roles in the CBA process.

1. Interdisciplinary Translator

During the CCAT CBA, each HSI practitioner was required to be an "interdisciplinary translator." That is, each member of the analysis team possessed the ability to speak the language of a systems engineer, acquisition professional, research scientist, bureaucratic leader, contractor, and warfighter. In turn, the ability to translate among all stakeholders was the integrating force behind a cohesive and joint team effort. Like any good translator, it is not enough for an HSI practitioner to simply memorize vocabulary. Each HSI practitioner should be knowledgeable enough in each discipline to understand each stakeholder's organizational structure, culture, practices, policies, procedures, and priorities. Knowing how and why a particular stakeholder operates enable the HSI practitioners to explain HSI principles and the long-term benefits of HSI in meaningful terms.

In order to be an interdisciplinary translator, an HSI practitioner must have the opportunity to learn different stakeholder languages, especially in the acquisition and engineering disciplines. Education programs like the NPS HSI master's degree program or HSI certificate program provide the knowledge needed to bridge the gap between each discipline and ultimately improves total system performance.

Due to the wide array of disciplines involved in acquisition-related studies, it is possible that a novice HSI practitioner will not have the requisite knowledge or expertise needed to be a good translator. For this reason, it is important that HSI practitioners invest time in building an HSI TTAMs toolbox. When knowledge is lacking in a certain area, an HSI practitioner can refer to a standard set of HSI TTAMs to gather the necessary information. Furthermore, networking with other HSI practitioners can also help augment expertise in areas where a practitioner has little knowledge. Inviting other HSI practitioners who are well-versed in specific areas or domains to comment or advise can significantly improve the acquisition process.

For the CCAT CBA, the analysis team had limited background knowledge or expertise in the medical field. Therefore, the analysis team reached out to the 711th HPW/HP HSI practitioners, one of whom was a physician, by inviting them to attend the

TIMs. With the help of the 711th HPW/HP HSI practitioners and the right selection of HSI TTAMs, the analysis team was able to communicate between and across the different CCAT organizations.

2. Resource Conscious

HSI practitioners must be conscious of stakeholder resources when making recommendations. During the recommendation process, it is not enough to present a list of expensive recommendations. One benefit of conducting an HSI-focused CBA is that HSI practitioners are aware of stakeholder resources and are capable of presenting reasonable tradeoffs.

During the CCAT CBA, a common misperception among the stakeholders and some SME was that materiel solutions could solve all the problems with the CCAT system. Unfortunately, many of these developmental materiel solutions relied on technology at lower technological readiness levels and required many years before they would be mature enough for use (e.g., synthetic blood or replenishable oxygen). For those stakeholders who have a vested interest in technological solutions, the HSI practitioner must explain the value behind non-materiel solutions and the additional effectiveness they can contribute to total system performance.

3. Systematic Investigators

For the most part, the SME were onboard with the analysis team's work on HSI; however, there were a few individuals who were quick to jump to technological solutions. It cannot be emphasized enough that the beginning processes of the CBA are just as important as the recommendations portion. Quality recommendations will not emerge if the analysis team does not analyze and define the problem accurately. An HSI-focused CBA requires a systematic process and a firm commitment to understanding the human stakeholders.

Additionally, the HSI practitioner must ensure that HSI-related language is incorporated in the problem definition. If HSI is not in the problem statement, it is possible that key HSI principles could be overlooked or eliminated when resources become constrained.

4. Human Advocate

The military's "adapt and overcome" philosophy has saved lives, won battles, and allowed the force to do more with less. However, this mentality is not appropriate in every situation and should never be used as an operating principle during system design and development. Too often, military personnel are pushed beyond their physical and mental limits due to poor planning or through an uncompromising adherence to outdated operational doctrine. This type of organizational practice negatively influences morale, discipline, and motivation, especially when the force feels like top-level leadership and decision makers do not have their best interest in mind. The HSI practitioner must fight against this mentality and must become the voice for the military service member against unsafe, inefficient, and ineffective practices.

Additionally, an advocate knows that numbers are not always an accurate picture of what is really happening. Although quantitative data are important, HSI practitioners must place as much emphasis on qualitative data. This point was especially applicable during the CCAT CBA process. Looking solely at one quantitative measure of effectiveness, the CCAT system has a mission success rate of over 99%. Therefore, one assumes that the system was operating almost perfectly. The analysis team did not make this assumption, and after getting to know the SME, they quickly found that this high mission success rate came at the cost of the safely, health, and well-being of the CCAT personnel who are willing to make physical, emotional, and mental sacrifices for their patients. Therefore, the success of the CCAT mission was based on the humans in the system choosing to adapt and overcome the various system inefficiencies. While patients survived, the price for their survival was paid by the extraordinary lengths CCAT team members went to, often at the risk of their own physical and psychological well-being.

In order to be an effective advocate, the HSI practitioner must understand who the users, operators, maintainers, supporters, and supervisors are; where they come from; what they do; how they do it; and what they have experienced. Without this knowledge, the HSI practitioner will not truly understand how military personnel are affected by the system. During the CCAT CBA process, the analysis team interacted regularly with the SME and got to know each one personally. Although this took additional time and effort,

knowing the SME' backgrounds provided great insight into how the CCAT system affected their morale, motivation, dedication to duty, disciple, ethics, and other important factors.

Furthermore, the analysis team was comprised of HSI practitioners with both military experience and formalized HSI education. This combination of expertise improved advocacy for CCAT personnel, because the analysis team members intrinsically understood the operational constraints, mission demands, and dynamics of the complex military environment. An HSI practitioner can only gain this valuable insight by being a military service member; therefore, it is extremely important that the military continues to educate officers in HSI and allow them to serve in billets in which they can effectively improve system design, development, and implementation.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

The analysis team provided recommendations for only 41 of the 183 tasks. Future research should continue where the analysis team left off by making recommendations for the remaining 142 tasks. Recommendations for all the tasks identified in the CCAT CBA will ensure all capability gaps are addressed regardless of likelihood or severity. This effort will allow for a smoother transition to subsequent Pre- Materiel Development Decision activities.

The CCAT CBA contains all the information needed for a Joint DCR; therefore, an ICD is not required. If there is no preceding ICD, the JCIDS Manual mandates that the Joint DCR "must include appropriate detail of an ICD with respect to the identified capability requirements and associated capability gaps" (Joint Capabilities Integration and Development System, 2012, p. B-21). The CCAT CBA formal report fulfills this requirement by providing sufficient background information, a thorough description of the CCAT system, a detailed explanation of the strategic significance of the CCAT mission, a step-by-step breakdown of the analytic process, and a comprehensive summary of potential non-materiel solutions in the form of DOTmLPF-P recommendations (Joint Capabilities Integration and Development System, 2012).

The Tactical Critical Care Evacuation Teams (TCCET), a newly formed subset of the CCAT system, begins the continuum of critical care at the point of injury. The TCCET mission is similar to a CCAT mission since both TCCET and CCAT teams are composed of a critical care physician, critical care nurse, and respiratory therapist; however, a TCCET is trained in combat survival and specializes in providing critical care in rotary aircraft with a smaller arsenal of equipment (Ricks, 2012). As an emerging strategic asset, the TCCET plays an important role in the joint environment and expands the capabilities of the CCAT system. The USAF should commission a CBA to study the TCCET mission using an HSI and DOTmLPF-P focus.

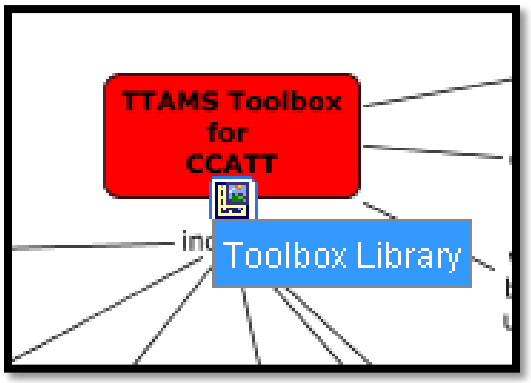
During the second TIM, the SME revealed that the aeromedical community lacks scientific evidence on the effects the airborne environment on the critical ill or wounded patients. Currently, aeromedical medical care is administered based on specific assumptions about these effects. There is a need for future research on how environmental factors like altitude, noise, vibration, temperature, motion, and air quality impact a patient's physiology. The lack of scientific knowledge in this area creates gaps in the domains of training, human factors engineering, safety, occupational health, environment, and habitability. In particular, training is hindered since the current training curriculum is not based on proven facts. Poor or inaccurate training can lead to unsafe medical practices, which could result in health hazards and habitability issues for the patient. Additionally, equipment and procedures developed through human factors engineering may not be the right solution since there is little understanding of how the airborne environment affects the patient.

Furthermore, there is a lack of scientific knowledge on how the airborne environment affects CCAT personnel performance. The CCAT CBA made assumptions that the airborne environment affects the CCAT personnel, patients, and equipment; however, the analysis team was unable to pinpoint the specific impacts. Future research should investigate the performance implications of the airborne environment for CCAT personnel, patients, and equipment.

APPENDIX A. HSI TOOLBOX WITH TTAMS LIBRARY

The CCAT HSI Toolbox was a "one-stop shop" that contains all the HSI related TTAMs needed to conduct Pre-MDD activities. Specifically, this toolbox was customized for the CCAT CBA, ICD, and DCR processes. The toolbox's layout and interface was created using the Institute of Human and Machine Cognition (IHMC) CmapTools Software. The software was free and worked on all operating systems.

There were many benefits to using the CCAT HSI Toolbox during the CBA process. First, the HSI Toolbox increased efficiency by placing TTAM support in one location. This streamlined data retrieval, simplifies data storage, and reduces desktop clutter. The HSI Toolbox eliminated the need for multiple folders, bookmarks, and opened windows. It did this by embedding the necessarily resources, instructions, websites, and programs in a specific node, which is shown below.



Second, the HSI Toolbox linked selected TTAMs to specific project documentation and resources. Figure 5 illustrates this benefit. This allowed the toolbox to evolve as the project progressed by tracking, documenting, and storing the team's efforts from the beginning to the end. The Toolbox provided a visual representation of how the team was approaching the problem and what needed to be completed. Furthermore, the HSI Toolbox was used as a traceability tool.

Last, the toolbox was user-friendly and very little training is needed. A new user could quickly learn the basic functionality without reading the instructions. Updating the

toolbox did not require a technical expert; therefore the team could manage it without outside assistance.

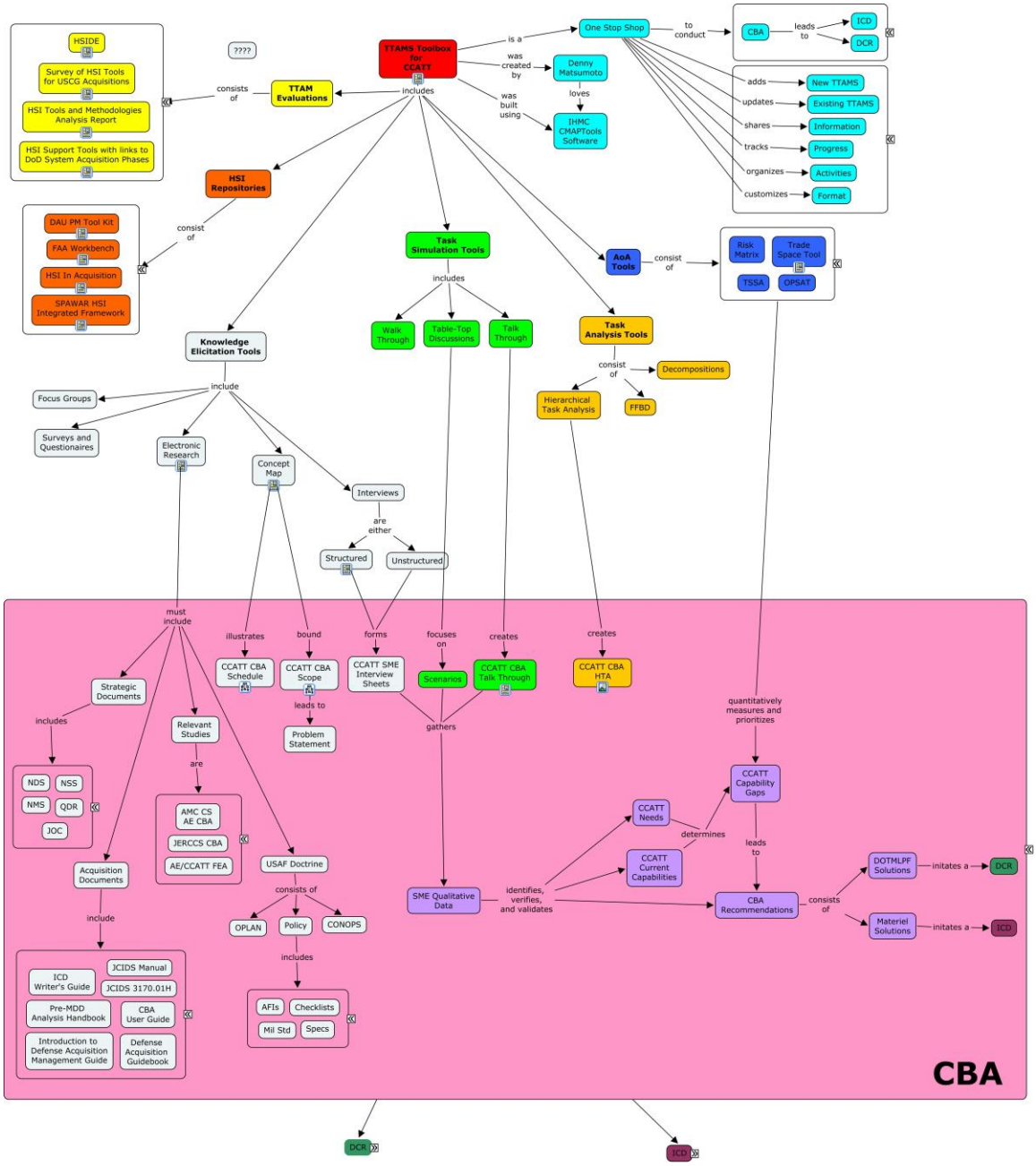
Despite the benefits, there are some limitations to the CCAT HSI Toolbox. As the project progressed, the concept map grew and it was hard to neatly organize all activities. Using nested nodes eliminated some of the clutter and the search function (CTRL+F) could be used to find specific items quickly. .

Unfortunately, sharing the HSI Toolbox was tricky. All embedded documents and website bookmarks had to be exported with the HSI Toolbox CMAP file. This proved to be difficult as the project progressed since the export was too large to transfer over email. One way to fix this issue was to put the HSI Toolbox in Sakai, or download it to the CmapTools Server. Using Sakai eliminated large data transfers by storing all documents in a central location. Although the CmapTools Server is also an option, it does not provide the same level of security as the other sights.

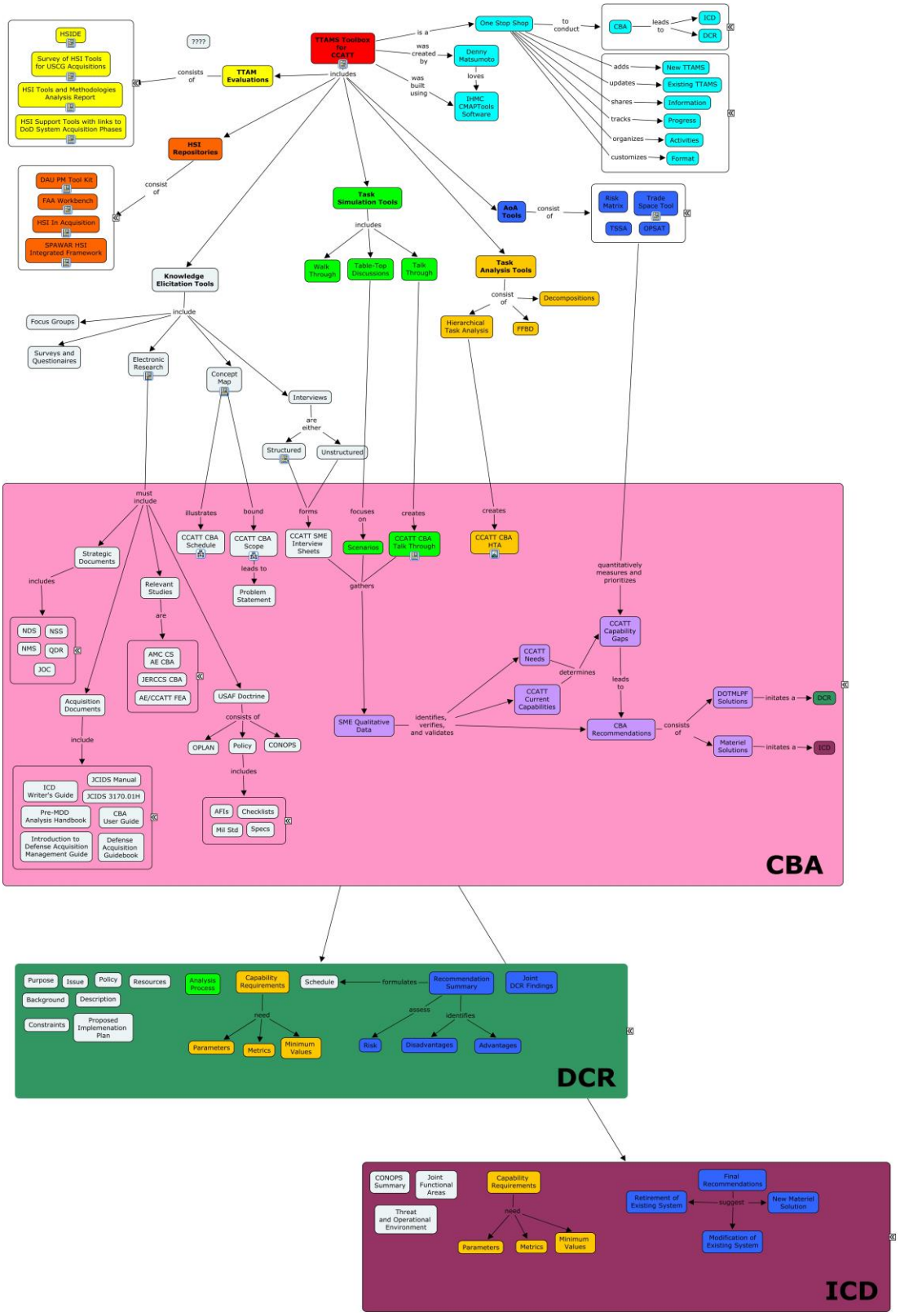
Furthermore, the HSI Toolbox is limited to electronic resources and documents. If it is crucial to add a hard copy resource into the toolbox, it must be scanned or a citation can be used as a placeholder in the CMAP.

Snapshots of the HSI Toolbox can be found below. The analysis team only completed the CBA activities; therefore there are no specific documents or resources for the ICD or DCR.

A. HSI TOOLBOX



B. EXPANDED HSI TOOLBOX



C. HSI TTAMS LIBRARY

TTAM	Description	Type	HSI Domains	CBA Applicability
Surveys	Objectively and systematically evaluates HSI related TTAMs and provides insight on TTAM selection.	TTAM Evaluations	All	Initial preparations for the CBA process requires the analysis team to formulate a plan, which includes when and how each TTAM will be used. HSI Practitioners must absolutely use these surveys when selecting what TTAMs will be needed.
Other Toolboxes	Contains TTAMs that are important to a specific organization. Most toolboxes describe when, how, and why a TTAM is used.	HSI Repositories	All	A major part of the CBA process is defining and scoping the problem. This is an iterative process and as more information is gathered, new TTAMs may be required that are not contained in this HSI Toolbox. HSI Practitioners must absolutely use other toolboxes to ensure no TTAM is overlooked.
Electronic Research	Historical data is gathered from different information sources to enhance an individual's knowledge by creating new perspectives, identifying historical trends, providing lessons learned, determining relationships, and improving overall awareness.	Knowledge Elicitation	All	The information gathered and the knowledge gained during the Pre-MDD builds the foundation of the system. Without research, a CBA will not accurately explain the current situation and will not recommend the right course of action. These TTAMs must absolutely be used if the project team does not have experience.
Literature Review				
Concept Map (CMAP)	Reveals natural groupings and relationships between concepts by using a hierarchical framework to organize knowledge (Novak & Canas, 2008). Broad concepts are decomposed into smaller ones, which provides a visual representation of the flow of information (Novak & Canas, 2008)	Knowledge Elicitation	All	CMAPs must absolutely be used during the CBA processes. CMAPs reveal relationships between CBA stakeholders, tasks, objectives, constraints, and boundaries. This helps define and scope the problem. Additionally, concept maps can be used as a traceability matrix and help Project Leads construct a CBA schedule.

TTAM	Description	Type	HSI Domains	CBA Applicability
Interviews	Verbal data is collected from personnel who are representative of the system's target population. Interviews can be structured using a bank of closed and open ended questions, or can be unstructured where a "think aloud protocol" is used (Kirwan & Ainsworth, 1992).	Knowledge Elicitation	All	This TTAM must absolutely be used if the project team does not have experience. During the CBA process, interviews with SME will help identify capability requirements, gaps, and recommendations to fill the gaps. Additionally, SME interviews will also verify and validate CBA progression to ensure it is an accurate representation of the target population.
Focus Groups	Verbal data is collected from a group who are representative of the system's target population in a group setting. Although there is usually an overarching topic, this TTAM is meant to facilitate discussion and group members can speak freely.	Knowledge Elicitation	All	Focus groups are a strong candidate for use during the CBA process. This TTAM brings together personnel with different perspectives to help scope the problem and can help identify capability requirements, gaps, and recommendations to fill the gaps.
Survey and Questionnaire	Qualitative and qualitative data is collected from the target population using a set of closed and open ended questions.	Knowledge Elicitation	All	This TTAM is a strong candidate for use during the CBA process, because it can gather both qualitative and quantitative information from a large sample.
Table-Top Discussion	A group of SME discuss a specific task and/or scenarios (Kirwan & Ainsworth, 1992).	Task Simulation	All	The JCIDS policy recommends using scenarios to pinpoint capability gaps, which is why this TTAM must absolutely be used during the CBA process. This TTAM allows SME to speak freely while working through a task or scenario. This group discussions helps identify the capability gaps.
Walk Through	A demonstration of how specific tasks are completed using the actual system, prototype, or mockup. These can be in real-time or a step by step breakdown (Kirwan & Ainsworth, 1992).	Task Simulation	All	This TTAM should definitely be considered in the CBA process, because users can physically show capability gaps in the system. During the CBA process, it may be hard to gain access to the system or prototypes/mock-ups.

TTAM	Description	Type	HSI Domains	CBA Applicability
Talk-through	An individual discusses how specific tasks are completed (Kirwan & Ainsworth, 1992).	Task Simulation	All	Talk-throughs are a strong candidate for use during the CBA process. Users can help pinpoint current capabilities and possible gaps in the system by describing the task.
Functional Decomposition	Tasks are broken down into main functions and sub functions using a hierarchical framework (Kirwan & Ainsworth, 1992).	Task Analysis	All	This TTAM is a strong candidate for use in the CBA process, because it can be used to analyze the relationship between system tasks and sub-task to determine if there are any problem areas that could lead to capability gaps.
Functional Flow Block Diagram (FFBD)	Tasks are broken down into a sequence of functions to determine the order of the functions, and pinpoints how they depend upon one another.	Task Analysis	All	This TTAM is a strong candidate for use in the CBA process, because FFBD can be used to develop Generic Task Structures. These can be used to analyze the current system's task sequences to determine if there are any problem areas that could lead to capability gaps.
Hierarchical Task Analysis (HTA)	Tasks are organized using a hierarchical framework to determine the relationship and order of each task and sub-task (Kirwan & Ainsworth, 1992).	Task Analysis	All	This TTAM is must absolutely be used during the CBA process. It can be used to analyze the current system capabilities. It can also be used as an organizational tool that can divide work, allocate resources, and track the team's progress
Tradespace for System Analysis (TSSA)	A scenario-based tool that determines the best alternative based on defined constraints and strategies.	Analysis of Alternatives	All	This TTAM is a strong candidate for use during the CBA process. Once the capability gaps are identified, will help the team objectively prioritize their recommendations.
Option Selection and Analysis Tool (OPSAT)	A decision tool that provides a quantitative value that ranks all alternatives to determine the most superior solution.	Analysis of Alternatives	All	This TTAM is a strong candidate for use during the CBA process. Once the capability gaps are identified, will help the team objectively prioritize their recommendations.

TTAM	Description	Type	HSI Domains	CBA Applicability
Risk Matrix	Quantitatively measures the probability and severity of risk.	Analysis of Alternatives	All	This TTAM must absolutely be used during the CBA process. Once the capability gaps are identified, a risk analysis will quantitatively determine the probability and severity of each gap if left unfilled. This will help the team prioritize their recommendations.
NPS Trade Space Tool	Provides quantifiable evidence needed when making tradeoffs between Manpower, Personnel, Training, Human Factors Engineering	Analysis of Alternatives	Manpower Personnel Training HFE	This TTAM is a strong candidate for use during the CBA process, especially when making Manpower, Personnel, Training, and HFE recommendations. A HSI Practitioner will gain insight to the bivariate relationship between two of these HSI domains, which will help them develop their recommendations.

APPENDIX B. RECORD OF DECISIONS

The CCAT CBA analysis team wrote the records of decisions from November 2012 to September 2013.

Date: 01 November 2012
Time: 0900-1000 PST
Decisions:

- The CBA scope and proposed schedule was discussed. All members agreed that the boundaries of the scope were appropriate at this stage of the project. All members agreed on the proposed schedule and timeline.
- Initial Problem statement was discussed. Members agreed that "HSI" needed to be emphasized and included into the problem statement. Next iteration is in progress.
- SURVIAC and NPS Turnover is complete.
- The Contact list will include ANG and Reserve personnel
- In accordance with the schedule, all October activities are complete. For November, contacts will be invited to participate in project, and scenarios will be developed.
- Meetings with NPS Team and 711th will be held monthly. Next meeting will be at the beginning of December.

Date: 08 November 2012
Time: 0900-1000 PST
Decisions:

- Team Lead will send the introductory email to CCAT SME and other POCs on 13 or 14 November 2012. Team Member 3 will be the team's primary POC and will make follow-up phones calls.
- IRB paperwork is in progress and will be completed no later than 30 November 2012.
- SIPRnet Accounts are setup and running at NPS. Team is continuing to research and develop scenarios.

Date: 15 November 2012
Time: 0900-1000 PST
Decisions:

- Introductory email to approximately 24 CCAT SME and POCs was sent on 14 November 2012. Many have responded and are willing to help. Follow-up phones calls are scheduled for the week of the 19th.
- Unclassified scenarios have been developed and are now being refined. Classified scenarios will be completed no later than 29 November 2012.
- Team discussed resilience engineering and believes this concept links the CBA. Team Member 3 will be investigating the concept's engineering perspective,

whereas Team Member 2 will be investigating the concept's human factors perspective. Overview of the resilience engineering literature will be conducted on 29 November 2012.

- Deputy Team Lead will be setting up a forum on the SAKAI website for the team to create an annotated bibliography of all references used.
- Weekly meeting for 22 November cancelled – Happy Thanksgiving! Next meeting scheduled for 29 November 2012.

Date: 29 November 2012
Time: 0900-1000 PST
Decisions:

- 13 out of 25 SME have agreed to be on the CCATT SME team and 6 out of the 8 organizations are represented by at least 1 SME. Team Member 3 will continue with follow-up phone calls.
- Team is in the process of researching and developing classified scenarios.
- Team is using the unclassified scenarios to help with identifying CCATT system capabilities.
- Resilience Engineering literature was discussed. Team agrees that resilience engineering is applicable to the CBA process and will continue researching it. Team Lead is going to schedule a conference call with David Woods. He is a SME in Resilience Engineering and should provide great insight on how the team can incorporate this discipline into our analysis.
- Meeting with NPS Team and 711th will be held 6 December at 0900 PST. Items to be discussed:
  the progress made, next month's agenda, and the preliminary plan for the February Workshop.

Date: 06 December 2012
Time: 0900-1000 PST
Decisions:

- Monthly progress review completed and 711th has been updated on all activities. Currently, the team is on track.
- CBA scope and problem statement are completed.
- SME team is formed and Team Member 3 will make another follow-up phone call to those who have not responded.
- Scenarios are being finalized and will be sent via email to the SME team before the Christmas holiday. SME will be asked to review scenarios and begin to identify CCAT capabilities.
- Team has begun to examine current capabilities. Capabilities document will be drafted prior to the SME Workshop and will be reviewed during the workshop. Final draft will be completed by the end of February.
- First SME Workshop tentatively scheduled for the week of the 25 February 2013. Location tentatively schedule for Wright Patterson Air Force Base in Tech Edge rooms. Team will begin planning the Workshop and confirm which SME team members are able to travel.

- Possible dates for 711th visit to Monterey, CA were discussed.
- NATO Flight Surgeon Conference will be held in Ramstein, Germany 11-15 March 2013. This may be a good opportunity to gain the international/joint perspective on AE and a possibility for cognitive walk throughs. More information is needed on the contents of the conference to ensure it is focused on Aeromedical issues.
- Thesis proposal and IRB are being reviewed. All members should complete the required CITI training if they would like to gather human subject data. All members of the NPS team are complete with the CITI training.
- A research effort on CCAT task mitigation and CRM is starting up. Team will extend a Workshop invite to this research group.
- A conference call with Dr. David Woods will be scheduled next week to discuss the applicability of Resilience Engineering to the CCATT CBA process.

Date: 17 January 2013
Time: 0900-1000 PST
Decisions:

- Monthly progress review completed and 711th has been updated on all activities. Currently, the team is on track.
- The data that we will be collecting is up for debate as to whether it is human subjects research. Consequently, the team is waiting to hear back from the Vice IRB Chair who has the final say on whether an IRB approval is needed. The IRB packet is complete; however, team is researching whether Team Member 3 will need an Individual Investigator Agreement or Federal Wide Assurance.
- Scenarios and Capabilities will be sent out to the SME once the IRB situation is resolved.
- SME are interested in participating in the Technical Interchange Meeting; however, the DoD wide travel restrictions and funding cuts are making it difficult for the SME to attend to the TIM. If these restrictions are not resolved before the TIM, there may be a need for Video Teleconference capabilities. Team Member 3 is currently exploring the VTC capabilities for the TIM. Catering for TIM is setup. List of supplies and TIM agenda is being developed.
- Currently, 7 SME are signed up for the TIM. Follow-up emails will be sent to those who have not replied to the invitation.
- Team members are working on traveling plans for the CCAT site visits and the NATO Flight Surgeon Conference in March 2013. Travel for 711th representatives is on hold until travel restrictions are lifted.
- Next Monthly Progress Review with 711th will be 7 February 2013.

Date: 24 January 2013
Time: 0900-1000 PST
Decisions:

- Germany site visit is on hold for both the 711th and NPS due to the traveling hold. There is a possibility for the trip in June. Since this trip is tentatively cancelled, the team discussed the possibility of a site visit to C-STARS after the February

TIM. The site visit is tentatively scheduled for 28 February and Team Member 3 is working the details.

- The Federal Wide Assurance form should be complete within the next couple of days. Once it is, the IRB packet will be routed to the NPS IRB department.
- There are still 8-9 SME who have not responded to the February TIM invitation. Last week, Team Member 3 sent out reminder emails. Next week, the team will be making calls to all non-respondents and to provide them the option of participating over VTC.
- The traveling freeze may cause changes to the planned agenda for the February TIM. The team discussed several options:
    - Best case scenario, the traveling freeze is lifted and SME can participate in a 2 day workshop.
    - Another scenario is that the traveling freeze is not lifted and only the local SME can participate in person. Those outside local area will participate using VTC. If this is the case, the agenda will be for a 1 and 2/3 day TIM for the local SME. The VTC participants will be asked to meet for two hours on the second day, where they will be used to evaluate and validate the findings.
    - Worst case scenario is that the traveling freeze is not lifted, and local SME can only participate in a 1 day TIM.

  Agendas for all scenarios are being formulated. Agendas will be created by the end of next week.
- NPS policy is only granting mission essential traveling. Once 711th HPW/HP Director deems this research "mission essential," Team Lead will route a memo to request authorization to travel to Dayton, Ohio for the February TIM.

Date: 31 January 2013
Time: 0900-1000 PST
Decisions:

- Team's sponsor has deemed the February TIM as "mission essential." Team Lead is in the process of routing a memo to request authorization to travel to Dayton, Ohio for the NPS team. There are no restrictions on Team Member 3's travel.
- The Agenda for the February TIM is complete for the best case scenario (2 day TIM) and worst case scenario (1 day TIM).
- The Federal Wide Assurance has not been signed yet, but Team Member 3 is in constant contact with her boss and is updating the team regularly on its progress.
- NPS HRPP Specialist suggested a few changes to the IRB. These have been discussed and changes have been made.
- Team continues to work on drafting scenarios and capabilities.

Date: 07 February 2013
Time: 0900-1000 PST
Decisions:

- Monthly progress review completed and 711th has been updated on all activities. Currently, the team is on track.
- Team is waiting for NPS to approve travel to February TIM. Team has begun making travel arrangements.
- During the TIM, sponsors may be dropping by.
- Team's tentative schedule for February TIM:
    - Team will arrive in Dayton, Ohio on 25 February.
    - TIM 26-27 February.
    - CSTARS Site Visit 28 February.
    - Meeting with USAFSAM SME 01 March.
    - Out-brief with Sponsor TBD (28 February or 01 March). Commander will coordinate time and date for the Out-brief.
    - Team will depart on 01-02 March.
- NPS Vice Chair has looked over the IRB packet. One change to the Consent Form is required before packet can be routed to NPS President. The change is complete and package has been resubmitted. The team is still waiting on Booze Allen signatures for the IAIR.
- Team has created the power point presentation and pre-briefed team on each slide.
- Tentative Agenda has been sent to all SME participating in the TIM.

Date: 14 February 2013
Time: 0900-1000 PST
Decisions:

- Update from BAH on the IAIR process. They are working the review at BAH and Team will coordinate with the 711th Human Research Protection Officer (HRPO) to help in this process.
- Team discussed data collection process and will continue to refine the data collection tool.
- Team will draft a glossary of all the terms that will be used during TIM.
- Team needs to add an amendment to the IRB so that we can record TIM interviews and discussions. This change will also be added to the consent form.

Date: 21 February 2013
Time: 0900-1000 PST
Decisions:

- WPAFB IRB Chair stated that a HRPO review was not required. Therefore, Team Member 3 is approved to participate. IAIR is being routed and is awaiting NPS President approval.
- Team has finalized logistics for the trip to Dayton. Team will now be staying at the Dayton Marriott instead of Comfort Suites.
- Amendment to the IRB for audio recording is being routed and is awaiting NPS President approval.
- A "reminder email" will be sent to all the SME prior to the TIM.

- Coordination and planning for the TIM lunch is complete. Catering is good to go for Tuesday and Wednesday.
- The team is finalizing the documents for SME packets and will be forwarding them to Team Member 3 by Friday to create the folders. The packets will include:
    - TIM Agenda
    - Consent Form
    - Definitions Document
    - Scenarios Document
    - Capabilities Excel
    - IRB Questions and Concept Map (Only the team members will have this)
- Team is looking into getting a large print out of the Scoping Concept Map. This is not a mandatory item. Team is looking into getting an easel paper pad.
- Introduction power point presentations are being finalized by Team Lead.
- Team will have 7 handheld recording devices for the TIM.
- Three SME will be attending the TIM via VTC.

Date: 07 March 2013
Time: 0900-1000 PST
Decisions:

- Monthly progress review completed and 711th has been updated on all activities. Currently, the team is on track.
- The Plan for the Month of March:
    - Build up the scenarios with more narrative in short story format. This will allow the team to combine the scenario introduction, the CCAT events/activities, and capabilities into one detailed document. This will be completed NLT 14 March 2013.
        - Irregular and Traditional: Team Member 3
        - Catastrophic and Disruptive: Team Member 6
    - Check classification for the scenarios and data with NPS Security Manager
    - Conduct detailed capabilities review
    - Develop mission, functions, and tasks
    - Send products to SME for verification and validation

Date: 14 March 2013
Time: 0900-1000 PST
Decisions:

- Team is working with the NPS Security Manager to provide guidance on scenario develop to ensure each one remains unclassified.
- The Team will use a top-down, bottom-up approach when developing the CCAT Scenarios. The scenarios will need to address several important issues that have come up in our data collection sessions:
    - Fatigue
    - CRM

    - Burnout
    - PTSD
    - Adrenaline Junkies
    - Resilience
    - Logistics of CCAT Equipment
    - Communication Flow of equipment purchasing
    - Communication flow (between CCATT, AE, those on the ground, and the hospital)
    - Training
    - Team Formulation
    - Tracking of personnel
- Final draft of the scenarios will be completed by 21 March 2013.
- The Mission, Function, Task analysis will build off these four scenarios.

Date: 22 March 2013
Time: 0900-1000 PST
Decisions:

- Team reviewed scenarios narratives. Final edits will be made by next week.
- Once scenarios are complete, the NPS Security Manager will look them over once complete.
- The Mission, Function, Task Analysis will be conducted next week using these scenarios.
- Two hour team meeting schedule for 28 March from 0900-1100.

Date: 28 March 2013
Time: 0900-1100 PST
Decisions:

- Team started the Mission, Function, and Task Analysis using the four scenarios. This analysis will be completed by 04 April 2013.
- On 01 April 2013 at 1000 PST, Team has scheduled a conference call with CCAT Fatigue Study Principle Investigator to discuss the CCAT Fatigue Data.
- The team meeting time for 04 April 2013 has been rescheduled to 1700 PST.
- Monthly Progress Meeting with 711th has been rescheduled to 11 April 2013.

Date: 15 April 2013
Time: 1000-1100 PST
Decisions:

- Team continues to work on Mission, Function, and Task Analysis using the four scenarios.
- CCAT Fatigue Study Principle Investigator has asked the team to help analyze the raw actigraph data from the CCAT Fatigue Study. Team is coordinating with the study's IRB chair, Colonel William Butler, to ensure the team is authorized to analyze the data. Computer is set up with all the actigraphy and FAST software to analyze the CCAT Fatigue Data.

- Planning has started for the next CCAT TIM. TIM is tentatively scheduled for June 2013.
- Team Member 3 is tentatively scheduled to visit Monterey in May for team meeting.
- Team is still working on getting access to JTTR for CCAT mission data.
- Team will meet on 18 April 2013.

Date: 18 April 2013
Time: 0900-1000 PST
Decisions:

- Team continues to work on Mission, Function, and Task Analysis using the four scenarios.
- CCAT Fatigue Study Principle Investigator is currently working on an Amendment to the CCAT Fatigue Study IRB Protocol and a Date Usage Agreement. Once complete, team will begin to analyze the study's data.
- TIM is tentatively scheduled for 18-19 June 2013.
- Team Member 3 will be in Monterey 13-16 May for team meetings.

Date: 26 April 2013
Time: 0900-1000 PST
Decisions:

- Data User Agreement for the USAF CCAT Fatigue Study has been signed by Team Lead and Chairman of the Operations Research Department at NPS. Paperwork is now being routed to USAFSAM.
- Team discusses the assumptions associated with the CCAT system. The following is a list of what the team knows to be true:
    - Altitude impacts physiology
    - Altitude impacts equipment
    - Environment affects performance
        - Noise
        - Vibration
        - Temperature
        - Lightening
        - Motion
        - Air Quality
        - Sanitation
        - Dehydration
        - Nutrition
        - Fatigue
        - PTSD
- Team Member 3's travel has been finalized for May 13-16.
- Tech Edge Facility has been reserved for June 18-19 for the next TIM.
- Team will now be meeting on Fridays at 0900-1000 PST.
- Monthly progress review with 711th will be conducted on 03 May 2013 at 0900-1000 PST.

Date: 03 May 2013
Time: 1200-1300 PST
Decisions:

- Monthly progress review completed and 711th has been updated on all activities. Currently, the team is working hard to get back on track with the gap analysis. Team will be working overtime during Team Member 3's visit to Monterey to get back on track for the June TIM.
- Invitation for the June TIM will be sent 6 May 2013 to all CCAT SME. Team will be working on the lunch menu and other administrative details.
- Team has been invited to an Aeromedical Exercise during the last week of September.
- A CCAT mental health study and medical record review is being conducted by the USAF. Team hopes to incorporate the results and finding from these different studies in the CBA report.
- Capabilities, Function, and Task Analysis will be finalized by next week. The initial findings will be sent out to several SME on 10 May 2013 to validate and verify team's progress. Team will make the phone conference appointments for May 14 from 0800-1130. For each scenario, team would like one doctor, one nurse, and one respiratory therapist.

Date: 10 May 2013
Time: 1330-1430 PST
Decisions:

- Due to a change in NPS policy, Team is no longer authorized to be the CCAT CBA Principle Investigator since Deputy Team Lead is also a Co-Investigator. The Principle Investigator is now the Chairman of the Operations Research Department at NPS. Team Lead is now a Co-Investigator. The team is currently working on an Amendment to the IRB paperwork and revising the applicable paperwork. The 711th will receive documentation from NPS to reflect this change.
- Team Member 3 arrives 13 May 2013. During this visit team will be validating the four scenarios and the Capability, Function and Task Analysis with the SME. Documents were sent out 10 May 2013. Follow up with the SME will be made over the phone and via email on 14 May 2013.
- Seven participants have registered for the June TIM.
- CCAT Fatigue PI notified the team that the CCAT Fatigue IRB paperwork is being finalized. Team will be discussing and formulating the actigraphy data analysis plan next week.

Date: 17 May 2013
Time: 1415-1445 PST
Decisions:

- Team Member 3 was in Monterey from 13-15 May. During her visit, team worked on the Capabilities, Function, and Task Analysis, scenarios, and actigraphy analysis.

- The Capabilities, Functions, and Task Analysis is almost complete and will be finalized by 20 May. The next step will be to identify and quantify the capability gaps.
- On 14-15 May, team conducted several phone conferences with CCAT SME to talk through and validate the four scenarios. Minor issues were identified and team will make the appropriate changes to the scenarios.
- The IRB paperwork for the CCAT Fatigue Study has been approved. Team formulated an actigraphy data analysis plan with CCAT Fatigue Study Principle Investigator. Team has the data and has begun scrubbing it using the actiwear software.
- Modifications to the NPS IRB paperwork have been routed to the Chairman of the Operations Research Department at NPS. Scientific Review Form has been completed by IRB Board Member.

Date: 23 May 2013
Time: 0830-1030 PST
Decisions:

- The Capabilities, Functions, and Task Analysis is complete and team is now working on a concept map to display the findings. During the analysis, team discovered several issues that need further discussion: TCCET; Conditions and Standards for each task.
- Preparations for the June TIM are being made. The Agenda has been drafted, lunch menu is finalized, and folders are being created.
- Team has begun scrubbing the CCAT Fatigue Study data. Initial scrub should be completed by 06 June.
- Team was able to obtain data on basic Patient Movement, CCAT Missions, and monthly process improvement.

Date: 31 May 2013
Time: 0900-1000 PST
Decisions:

- 711th visit to Monterey is tentatively scheduled for 23-25 July. Team is tentatively scheduled to visit Dayton for debrief on 16-23 September.
- TIM Agenda is being finalized and will be sent out to the SME on 13 June.
- Capabilities Concept Map will be completed by 11 June so it can be printed and ready for the TIM.
- NPS IRB Amendments have been approved. the Chairman of the Operations Research Department at NPS is officially the Principal Investigator for the CCAT CBA.

Date: 28 June 2013
Time: 0900-1000 PST
Decisions:

- The Capabilities CMAP and scenarios has been updated with the feedback from TIM #2. Additionally, a summary of the TIM has been drafted in a memorandum and will be sent out to SME once finalized.
- Team has begun working on the CBA risk assessment. Team discussed different ways to quantify and define the likelihood and severity of risk.
- During the TIM, the team met with CCAT Fatigue Study Principle Investigator and USAFSAM SME to discuss the CCAT Fatigue data. Data has been scrubbed and team is analyzing it using graphs, repeated measures ANOVA, and FAST Software. Team will complete analysis by 12 July and provide CCAT Fatigue Study Principle Investigator with the two databases of scrubbed data, notes on the scrubbing process, and a summary of our findings.
- Furlough days are on Fridays; therefore, weekly CCAT CBA team meetings will be conducted on Thursdays at 1000 PST. All team members will be on vacation next week, so the 711th monthly progress review is tentatively re-scheduled for 11 July at 0800 PST.

Date: 15 July 2013
Time: 1200-1300 PST
Decisions:

- 711th visit to Monterey is scheduled for 23-25 July. Team Member 3 will also be in Monterey during that time. The focus for the visit is to update the 711th on CBA progress and begin the CBA risk assessment. Notes from TIM #1 and #2 have been sent to 711th representatives as a reference.
- Final Fatigue Report has been completed and will be sent to CCAT Fatigue Principle Investigator this week.
- Weekly meeting for 18 July has been cancelled since team will be meeting face-to-face next week.

Date: 01 August 2013
Time: 1530-1630 PST
Decisions:

- During 711th visit to Monterey, team completed the initial severity and probability rating for each task. This analysis was sent to 21 SME to validate on 26 July 2013. Currently, four SME have responded. Follow-up phone calls have been scheduled and will take place 05-09 August.
- Outline of CBA report has been drafted and will be finalized by 05 August 2013.

Date: 08 August 2013
Time: 1630-1730 PST
Decisions:

- Outline of CBA report has been finalized and writing has begun.
- Team continues to validate the Needs Assessment ratings. Currently, 12 follow-up phone calls have been made. The team will be compiling data and conducting a statistical analysis to determine which gaps are the most severe and probable. The statistical analysis will be completed by 16 August.

Date: 15 August 2013
Time: 1630-1730 PST
Decisions:

- Validation of the Needs Assessments has been completed. The team is determining the best way to analyze this data in order to rank order the capability gaps.
- Progress is being made on the CBA Report. Citation format and bibliography need to be standardized. Team will use APA style.
- Cost estimation on the CCAT mission has been completed.

Date: 23 August 2013
Time: 1000-1100 PST
Decisions:

- CBA report has been drafted. All sections are complete except for the discussion on the statistical analysis and recommendations.
- Team is finalizing the statistical analysis methodology and results. All statistical analysis will be completed by 30 August 2013.
- Team is formulating recommendations. Recommendations will be complete by 6 September.

Date: 30 August 2013
Time: 0900 – 1000 PST
Decisions:

- The team constructed a task-based risk matrix based on the severity and likelihood ratings. This matrix will supplement the statistical analysis and provides a visual representation of how the capabilities/functions/tasks compare to one another.
- The team constructed a recommendation matrix for the tasks with the highest risk. The matrix will determine what DOTmLPF-P areas and HSI Domains are needed to fill the capability gaps associated with the tasks. The team has completed the recommendation matrix for the top 10 riskiest tasks.

Date: 6 September 2013
Time: 0900 – 1000 PST
Decisions:

- Monthly progress review completed and 711th has been updated on all activities. The team is on track for the sponsor's debrief presentation on 24 September. Several SME will be invited to the presentation.
- Recommendation matrix is complete. Team formulated task-specific recommendations for forty of the most risky tasks. Team is currently working on 15 over-arching recommendations for each of the HSI domains and DOTmLPF-P areas.
- Final report will be complete once recommendations are finalized.

Date: 13 September 2013
Time: 1500 – 1600 PST
Decisions:

- The team is finalizing the recommendations and making final edits on the report.
- The team is working on the presentation for the sponsor's debrief on 24 September. Outline for the power point is complete.

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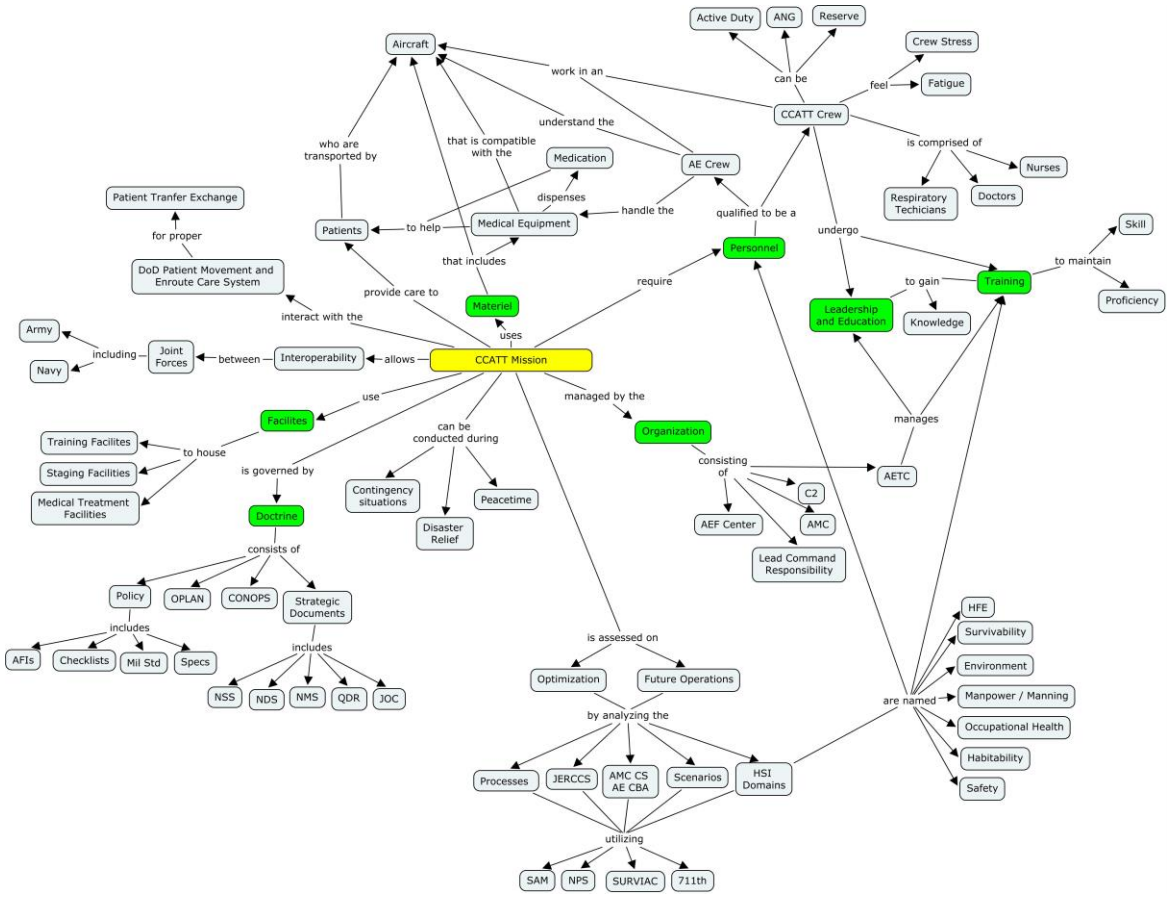
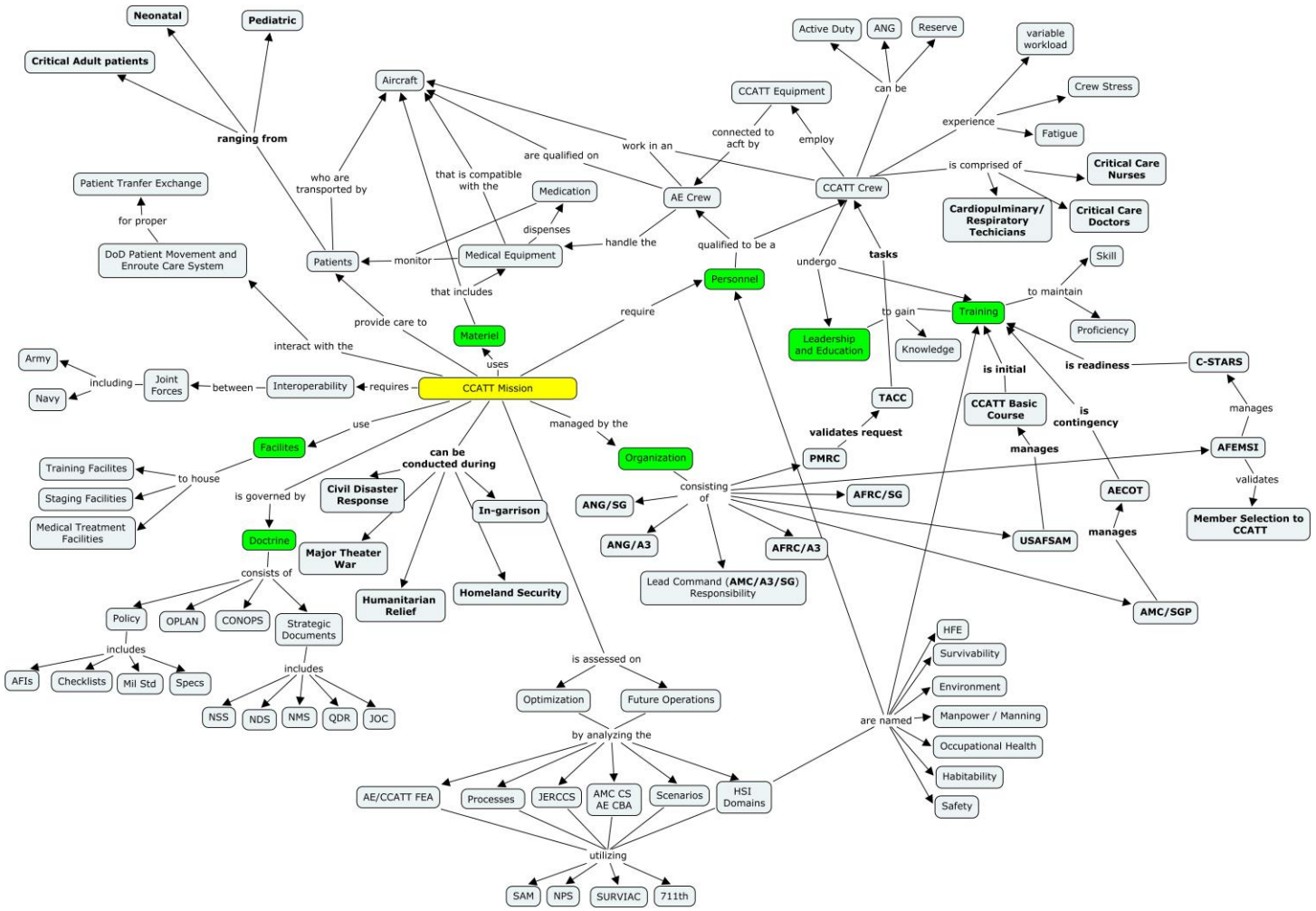
APPENDIX C. CCAT CBA CONCEPT MAP ITERATIONS

The CCAT CBA analysis team created the following iterations of the concept maps.

A. FIRST ITERATION



B. SECOND ITERATION



APPENDIX D. CCAT CBA PROBLEM STATEMENT ITERATIONS

The CCAT CBA analysis team created the following problem statement iterations.

A. FIRST ITERATION

To identify capability gaps in the CCATT system and provide prioritized DOTMLPF recommendations that will improve system performance, optimize system resources, and ensure the system accomplishes current and future missions effectively and efficiently.

B. SECOND ITERATION

Using Human Systems Integration principles and focusing on human aspects of the CCATT system, this effort will identify current and future capability gaps in the CCATT system, providing prioritized DOTMLPF recommendations that will close those gaps, optimize system performance and minimize cost and risk.

C. THIRD ITERATION

Use a Human Systems Integration framework to focus on the human aspects of the Critical Care Air Transport Team (CCATT) system, identifying current and future capability gaps and providing prioritized DOTMLPF recommendations that will close those gaps, optimize system performance and minimize cost and risk.

D. FOURTH ITERATION

Using Human Systems Integration principles, this effort will identify current and future capability gaps in the Critical Care Air Transport Team (CCATT) system, provide prioritized DOTMLPF recommendations that will close those gaps, optimize system performance and minimize cost and risk.

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APPENDIX E. CCAT CBA LITERATURE REVIEW

The CCAT CBA analysis team created the literature review table. This table was included in the CCAT CBA final report.

Title	Type of Reference	Author(s) / Office of Primary Responsibility	Date
59th Medical Wing Instruction 10-2901, Critical Care Air Transport Team, Policy, Procedures and Operation	Air Force Instruction	CCATT Pilot Unit Leader	31-Jan-11
AFDD 4-02 Heath Services	Air Force Doctrine	LeMay Center/DD	28-Jul-11
AFPD 10-3 Air Reserve Component	Directive	HQ USAF/A3/5GH	17-May-06
AFDD 3-17 Air Mobility Operations	Directive	LeMay Center/DD	1-Mar-06
AFPD 10-21 Air Mobility Command Roles and Responsibilities	Directive	HQ AMC/XPX	1-May-98
AFI 10-2909 AE Equipment Standards	Air Force Instruction	HQ AMC/A3VM	19-May-08
AFI 10-401 Air Force Operations Planning and Execution	Air Force Instruction	AF/A5XW	13-Mar-12
AFI 10-403 Deployment Planning and Execution	Air Force Instruction	HQ USAF/A4RX	13-Jan-08
AFI 11-2AEV1 AE Aircrew Training	Air Force Instruction	HQ AMC/A3TM	24-Jun-10
AFI 11-2AEV2 AE Aircrew Evaluation	Air Force Instruction	HQ AMC/A3VM	16-Sep-11
AFI 11-2AEV3 AE Operations Procedures	Air Force Instruction	HQ AMC/A3VM	18-May-10
AFI 11-402 Flying Operations	Air Force Instruction	AF/A3O-AT	13-Dec-10
AFI 11-405 Pilot Physician Program	Air Force Instruction	AF/SG3P	21-Apr-11
AFI 36-2905 AF Fitness Program	Air Force Instruction	HQ USAF/A1P	1-Jul-10
AFI 41-106 Medical Readiness Program Management	Air Force Instruction	AFMSA/SGX	1-Jul-11
AFI 41-209 Medical Logistics Support	Air Force Instruction	AFMOA/SG3SL	23-Nov-10
AFI 41-301 Worldwide AE System	Air Force Instruction	HQ AMC/SGX	1-Aug-96

Title	Type of Reference	Author(s) / Office of Primary Responsibility	Date
AFI 41-307 AE Patient Considerations and Standards of Care	Air Force Instruction	HQ AMC/SGN	5-Jul-11
AFI 44-165 AE Staging	Air Force Instruction	HQ AMC/SGX	6-Nov-07
AFPD 10-29 Worldwide AE Operations	Instruction	HQ AMC/DA3O	6-Aug-07
AFTTP 3-42.5 AE Tactical Doctrine	Air Force Tactics, Techniques, and Procedures	HQ/USAF/SGMD (Lt Col Fred Stone)	1-Nov-03
AFTTP 3-42.51 CCATT Tactical Doctrine	Air Force Tactics, Techniques, and Procedures	HQ AMC/SGP	7-Sep-06
C-STARS AFSC Training Breakdown	Training Material	C-STARS	No date
DODI 1322.24 Medical Readiness Training	DOD Instruction	Under Secretary Defense for Personnel and Readiness	6-Oct-11
DODI 6000.11 Patient Movement	DOD Instruction	OSD	9-Sep-98
Joint Publication 1 Doctrine for the Armed Forces of the United States	Doctrine	Chairman of the Joint Chiefs of Staff	20-Mar-09
Joint Publication 4-02 Doctrine for Health Services Support in Joint Operations	Doctrine	Chairman of the Joint Chiefs of Staff	30-Jul-01
Joint Publication 4-02.1 Joint Tactics, Techniques, and Procedures for Health Service Logistics Support in Joint Operations	Doctrine	Chairman of the Joint Chiefs of Staff	6-Oct-97
Joint Publication 4-02.2 Joint Tactics, Techniques and Procedures for Patient Movement in Joint Operations	Doctrine	Chairman of the Joint Chiefs of Staff	30-Dec-06
Joint Publication 3-17 Joint Doctrine and Joint Tactics, Techniques, and Procedures for Air Mobility Operations	Doctrine	Chairman of the Joint Chiefs of Staff	14-Aug-02

APPENDIX F. INVITATION EMAIL

The SME invitation email was created by the CCAT CBA Team Lead and HSI Consultant.

<Official Title><Name>,
Greetings from the Naval Postgraduate School (NPS). As you may recall the 711th Human Performance Wing (HPW)/Human Performance Directorate (HP) conducted a Front End Analysis (FEA) of Aeromedical Evacuation (AE) and the Critical Care Air Transport Team (CCATT) a few months back. The FEA is complete and NPS has joined the 711th HPW/HP to conduct the next phase. Together we are conducting a Capabilities Based Assessment (CBA) focused on CCATT.

We are currently in the process of identifying subject matter experts (SME) to include in the NPS research study. Because your inputs were critical to the FEA, we would like to request your participation in this CBA. Over the next year, we will contact you to ensure we are representing CCATT accurately and request your participation in fully funded workshops located either at Wright-Patterson AFB or the NPS in Monterey, CA. Specifically, you will be asked to participate in interviews and discussions regarding the CCATT mission.

The anticipated benefit from this research study is that it will improve and optimize the system so CCATT members are able to perform their duties more safely, effectively, and efficiently. The CCATT mission is an American tradition that has saved thousands of lives by providing airborne medical care to the critically sick and wounded. This research study will ensure the CCATT legacy remains resilient to future changes in national strategy, policies, technology, weaponry, operating environment, and enemy tactics. Please be aware that you may feel uncomfortable answering certain questions and discussing certain topics. Participation in this research could provoke negative feelings.

Your participation in this research study is strictly voluntary. If you are interested, please contact <Name> who is Cc'd above. You may recall <Name> was a member of the FEA team. If you have any questions or comments about the research please contact the Principal Investigator, <Name>, <phone #>, <email>. Questions about your rights as a research subject or any other concerns may be addressed to the Navy Postgraduate School IRB Vice Chair, <Name>, <phone #>, <email>. If you are unable to act as a SME or have others you feel should be a SME for this effort, please feel free to forward this email to them. Thank you. We look forward to working with you.

Best regards,
<Team Project Lead>

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APPENDIX G. PRELIMINARY ANALYSIS OF CCAT CBA SCENARIOS AND CAPABILITIES

The preliminary analysis of the scenarios and capabilities was created by the CCAT CBA analysis team. A portion of this analysis was included in the CCAT CBA final report.

Scenario Category	Enemy	Threat
Traditional - states employing recognized military capabilities/ forces in well-understood forms of military competition /conflict.	China	We will continue to monitor carefully China's military developments and the implications those developments have on the military balance in the Taiwan Strait. We remain concerned about the extent and strategic intent of China's military modernization, and its assertiveness in space, cyberspace, in the Yellow Sea, East China Sea, and South China Sea." *NMS*
Irregular - come from those employing "unconventional" methods to counter traditional advantages of stronger opponents	Terrorists	"Readiness, too, must remain a top priority, as our forces, systems, and capabilities will continue to be under extraordinary stress. Readiness is the ability to provide and integrate capabilities required by Combatant Commanders to execute their assigned missions. Restoring readiness will help improve our strategic depth to conduct full-spectrum operations, which has been degraded by sustained combat. Short term efforts to improve readiness will focus on resetting equipment and reconstituting units, in some cases--most notably rotational and expeditionary forces--this will be in stride. As we reset, we will conduct more full-spectrum joint, combined, interagency, and multinational training, exercises and experimentation. Forward presence and engagement will take on greater importance during this time. Long-term modernization efforts will improve readiness by developing essential capabilities and capacity to outpace emerging threats. A further degradation of readiness for the full range of military operations would undermine our ability to fulfill our national defense objectives – an unacceptable risk." *NMS*
Catastrophic -acquisition, possession, and use of WMD or methods producing WMD-like effects	Iran, Terrorists	"We will support efforts to counter transnational and sub-state militant groups, and combat the spread of WMD and related materials. We will maintain an appropriate presence capable of reassuring partners and allies and preventing Iran from acquiring nuclear arms." *NMS*
Disruptive - may come from adversaries who develop and use breakthrough technologies to negate current US advantages in key operational domains	China	"We remain concerned about the extent and strategic intent of China's military modernization, and its assertiveness in space, cyberspace, in the Yellow Sea, East China Sea, and South China Sea. To safeguard U.S. and partner nation interests, we will be prepared to demonstrate the will and commit the resources needed to oppose any nation's actions that jeopardize access to and use of the global commons and cyberspace, or that threaten the security of our allies." *NMS*

Prelim. CCAT Current Capabilities

Objective	Secondary Objective	Broad Capability	Specific Capability		
Support MTF and AE staging facilities	Maintain clinical skills while in the deployed environment and ensure patients are being classified appropriately.	**CCATT Team** -Provide support on non-CCATT patient reception and triage.	**CCATT Team has the ability to…..** 1. Apply restraints 2. Conduct infection control 3. Conduct pain management 4. Handle a ventilator 5. Handle an infusion pump 6. Handle blood gas analyzer Handle defibrillator 7. Handle intracranial pressure monitor 8. Handle oxygen analyzer 9. Handle physiologic monitor 10. Operate oxygen systems 11. Package patients for transport 12. Provide Advanced Cardiac Life support (ACLS) 13. Provide Advanced Trauma Life Support 14. Provide basic hemodynamic monitoring	15. Provide basic hemodynamic monitoring 16. Provide critical care 17. Provide infection control 18. Provide intracranial pressure monitoring 19. Provide mechanical ventilation 20. Recognize aerospace physiology impacts on patients 21. Transport blood and blood products 22. Transport burn patients 23. Transport medical patients 24. Transport patients with pulmonary conditions 25. Transport trauma patients 26. Transport traumatic brain injury patients 27. Treat acute respiratory failure	28. Treat cardiac disorders 29. Treat effects of positive/negative G forces 30. Treat effects of pressure change 31. Treat hyperventilation 32. Treat hypoxia 33. Treat mental health disorders 34. Treat mission/self imposed stress 35. Treat musculoskeletal disorders 36. Treat neurological disorders 37. Treat physiological effects of rapid decompression 38. Treat respiratory disorders 39. Treat shock 40. Operate on any cargo aircraft Ref. *CCATT Course Planning Document*
		CCATT Team -Provide support on critically ill patients, assess the patients clinical status for flight.			

Objective	Secondary Objective	Broad Capability	Specific Capability		
Provide specialized care, in conjunction with AE crews, to evacuate critical patients requiring advanced care during transportation	Advise and/or support other patient care issues when requested by the MCD or indicated by observed patient deterioration or instability	**CCAT Team -**Provide advanced specialty medical capability to patients who were not critical, but become critical while under the care of the AE crew.	**CCATT Team has the ability to…..** 1. Apply restraints 2. Conduct infection control 3. Conduct pain management 4. Handle a ventilator 5. Handle an infusion pump 6. Handle blood gas analyzer Handle defibrillator 7. Handle intracranial pressure monitor 8. Handle oxygen analyzer 9. Handle physiologic monitor 10. Operate oxygen systems 11. Package patients for transport 12. Provide ACLS 13. Provide Advanced Trauma Life Support 14. Provide basic hemodynamic monitoring	15. Provide basic hemodynamic monitoring 16. Provide critical care 17. Provide infection control 18. Provide intracranial pressure monitoring 19. Provide mechanical ventilation 20. Recognize aerospace physiology impacts on patients 21. Transport blood and blood products 22. Transport burn patients 23. Transport medical patients 24. Transport patients with pulmonary conditions 25. Transport trauma patients 26. Transport traumatic brain injury patients	27. Treat acute respiratory failure 28. Treat cardiac disorders 29. Treat effects of positive/negative G forces 30. Treat effects of pressure change 31. Treat hyperventilation 32. Treat hypoxia 33. Treat mental health disorders 34. Treat mission/self imposed stress 35. Treat musculoskeletal disorders 36. Treat neurological disorders 37. Treat physiological effects of rapid decompression 38. Treat respiratory disorders 39. Treat shock 40. Operate on any cargo aircraft Ref. *CCATT Course Planning Document*
	Maintain/enhance the standard of care provided to critically ill patients who require continuous stabilization and advanced care during transport to the next level of care.	**CCAT Team** - Provide advanced specialty medical care to continuously monitor and maintain stabilization of critically ill patients during patient movement activities in either an inter- or intra- theater AE mission support role.			
	Maintain/enhance the standard of care provided to critically injured patients who require continuous stabilization and advanced care during transport to the next level of care.	**CCAT Team -** Provide advanced specialty medical care to continuously monitor and maintain stabilization of critically injured patients during patient movement activities in either an inter- or intra- theater AE mission support role.			

Objective	Secondary Objective	Broad Capability	Specific Capability	
Provide specialized care, in conjunction with AE crews, to evacuate critical patients requiring advanced care during transportation	Maintain/enhance the standard of care provided to critically **burned** patients who require continuous stabilization and advanced care during transport to the next level of care.	**CCAT Burn Extender Team**- Provide advanced specialty medical care to continuously monitor and maintain stabilization of critically burned patients during patient movement activities in either an inter- or intra- theater AE mission support role.		
	Maintain/enhance the standard of care provided to critical **pediatric** patients who require continuous stabilization and advanced care during transport to the next level of care.	**CCAT Pediatric Extender Team**- Provide advanced specialty medical care to continuously monitor and maintain stabilization of critical pediatric patients during patient movement activities in either an inter- or intra- theater AE mission support role.	**CCAT Pediatric Extender Team has the ability to…** 1. Provide care for patients 3 months to 14 years 2. Assess airway and breathing 3. Assess airway patency 4. Assess breathing 5. Assess circulation 6. Assess Signs/Symptoms of Severe Respiratory Distress 7. Assess Signs/Symptoms of Respiratory Failure 8. Treatment/Management of Respiratory Distress/Respiratory Failure 9. Conduct a rapid cardiopulmonary assessment 10. Monitor blood pressure	11. Monitor mental status/level of activity 12. Monitor respiratory rate 13. Monitor skin color 14. Monitor urine output 15. Monitor vital signs: heart rate 16. Package patient for flight 17. Identify Special Pediatric Conditions Predisposing a Patient to Cardiopulmonary Arrest 18. Treat stresses of flight for pediatric patients 19. Operate on any cargo aircraft Ref. *AFI 41-307 Aeromedical Evacuation Patient Considerations and Standards of Care*

Objective	Secondary Objective	Broad Capability	Specific Capability	
Provide specialized care, in conjunction with AE crews, to evacuate critical patients requiring advanced care during transportation	Maintain/enhance the standard of care provided to critical **neonatal** patients who require continuous stabilization and advanced care during transport to the next level of care.	**CCAT Neonatal Extender Team**- Provide advanced specialty medical care to continuously monitor and maintain stabilization of critical neonatal patients during patient movement activities in either an inter- or intra- theater AE mission support role.	**CCAT Neonatal Extender Team has the ability to…** Provide care for patients birth to 3 months 1. Assess airway and breathing 2. Assess airway patency 3. Assess breathing 4. Assess circulation 5. Assess Signs/Symptoms of Severe Respiratory Distress 6. Assess of Signs/Symptoms Respiratory Failure 7. Treatment/Management of Respiratory Distress/Respiratory Failure 8. Conduct a rapid cardiopulmonary assessment 9. Monitor blood pressure	11. Monitor mental status/level of activity 12. Monitor respiratory rate 13. Monitor skin color 14. Monitor urine output 15. Monitor vital signs: heart rate 16. Package patient for flight 17. Identify Special Pediatric 18. Conditions Predisposing a Patient to Cardiopulmonary Arrest 19. Treat stresses of flight for pediatric patients 20. Operate on any cargo aircraft Ref. *AFI 41-307 Aeromedical Evacuation Patient Considerations and Standards of Care*
Evacuate patients to US Army Medical Research Institute of Infectious Disease (USAMRID) (Holder presentation - CCATT Brief 2007)	Transport patient while minimizing risk of transmission to aircrew, care givers, and civilians (Holder presentation - CCATT Brief 2007)	**VICKERS Transport Team** - evaluates and transports infectious and contagious patients. (Holder presentation - CCATT Brief 2007)	**VICKERS team has the ability to…** 1. Transport patients with unknown disease 2. Transport patients with viral hemorrhagic fevers 3. Transport patients affected by biological attack 4. Deploy a portable containment laboratory with rapid diagnostic assays 5. Deploy standard clinical laboratory support	6. Deploy with 6 to 12 hours notification 7. Operate on any cargo or rotary wing aircraft 8. Evacuate patients to US Army Medical Research Institute of Infectious Disease(USAMRID) Ref *http://wwwnc.cdc.gov/eid/article/5/2/99-0208_article.htm"* *(Holder presentation - CCATT Brief 2007)*

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APPENDIX H. CCAT CBA CONSENT FORM

The consent form was created by the CCAT CBA analysis team.

Naval Postgraduate School
Consent to Participate in Research

Introduction. You are invited to participate in a research study on the United States Air Force Critical Care Air Transport Team (CCATTs). The purpose of the research is to conduct a Capabilities Based Assessment on the CCATTs. If you agree to participate I will ask you to help identify current and future capability gaps in CCATT, assess the risk associated with those gaps, and provide recommendations to mitigate the risks. Also, I will ask you to verify and validate our findings to ensure they are an accurate representation of the target population.

Procedures. Today you will be asked to participate in interviews and discussions regarding the CCATT mission. The interviews and discussion may be administered individually or in small groups. Interviews and discussions will last approximately 1.5 hours each. If participating in the Technical Interchange Meeting (TIM), each day will last approximately 6-8 hours with periodic rest breaks. Please feel free to leave and take breaks at your convenience. You are welcome to add additional comments at your convenience. After the completion of the interview, discussion, and/or TIM, you may be contacted for follow-up information.

Location. The interviews and discussions will be held in person, over the phone, and/or through email. The TIM will take place at Wright Patterson Air Force Base in Dayton, Ohio and/or at the Naval Postgraduate School in Monterey, California.

Cost. There is no cost to participate in this research study.

Voluntary Nature of the Study. Your participation in this study is strictly voluntary. If you choose to participate you can change your mind at any time and withdraw from the study. You will not be penalized in any way or lose any benefits to which you would otherwise be entitled if you choose not to participate in this study or to withdraw. The alternative to participating in the research is to not participate in the research.

Audio Recording. Interviews and discussions will be recorded. The audio recordings will ensure the data is transcribed accurately and will be used only for this purpose. All recordings will be properly destroyed following transcription. If you do not want to be recorded you can withdraw from the study at any time.

Potential Risks and Discomforts. Please be aware that you may feel uncomfortable answering certain questions and discussing certain topics. Participation in this research could provoke negative feelings.

Anticipated Benefits. You will not directly benefit from this research.

Compensation for Participation. No tangible compensation will be given.

Confidentiality & Privacy Act. Any information that is obtained during this study will be kept confidential to the full extent permitted by law. All efforts, within reason, will be made to keep your personal information in your research record confidential but total confidentiality cannot be guaranteed. No identifying information will be connected to your responses and all data will be kept in a secure, locked location. Please be respectful of other participants' privacy by keeping all interviews, and discussions confidential. Please keep the group composition and participants' identifying information private.

Points of Contact. If you have any questions or comments about the research, or you experience an injury or have questions about any discomforts that you experience while taking part in this study please contact the Principal Investigator, <name removed>. Questions about your rights as a research subject or any other concerns may be addressed to the Navy Postgraduate School IRB Vice Chair, <name removed>

Statement of Consent. I have read the information provided above. I have been given the opportunity to ask questions and all the questions have been answered to my satisfaction. I have been provided a copy of this form for my records and I agree to participate in this study. I understand that by agreeing to participate in this research and signing this form, I do not waive any of my legal rights.

_____ _____

Participant's Signature Date

_____ _____

Researcher's Signature Date

APPENDIX I. TIM 1 DEFINITIONS HANDOUT

The CCAT CBA analysis team created the TIM 1 definitions handout. This handout was included in the CCAT CBA final report.

Definition of Terms

Capabilities Based Assessment (CBA) – describes the capabilities needed to perform a particular mission; identifies gaps in those capabilities and the associated operational risks; and there is a need to address these gaps (Force Structure, Resources, and Assessments Directorate, 2009, p. 7).

Capability – the ability to achieve an objective in a military operation (Force Structure, Resources, and Assessments Directorate, 2009, p. 7).

> It is important to describe "needs in terms of capabilities, instead of systems or force elements." In other words, a capability is not a specific solution. For example, a solution is described as "we need a more advanced fighter." A capability is described as "we need the capability to defeat enemy air defenses" (Force Structure, Resources, and Assessments Directorate, 2009, p. 5).
>
> **Terms used by CBA Team**:
> ***Overarching Capability*** – see above definition
> ***Subordinate Capability*** - Any subsequent capability that aids in achievement of a military operation

Capability Gap – The inability to execute a specified course of action. The gap may be the result of no existing capability, lack of proficiency or sufficiency in an existing capability solution, or the need to replace an existing capability solution to prevent a future gap (Joint Capabilities Integration and Development System , 2012, pp. GL-7)

Capability Need – A capability which is required to meet an organization's roles, functions, and missions in current or future operations. To the greatest extent possible, capability requirements are described in relation to tasks, standards. If a capability requirement is not satisfied by a capability solution, then there is also an associated capability gap which carries a certain amount of risk until eliminated (Joint Capabilities Integration and Development System , 2012, pp. GL-7)

Mission – The objective or task, together with the purpose, which clearly indicates the action to be taken (Defense Acquistion University, 2011, pp. B-165)

Objective – Mission outcomes and associated desired effect (Joint Capabilities Integration and Development System , 2012, pp. A-B-2)

Terms used by CBA Team:

Overarching Objective – see above definition

Subordinate Objective – Any subsequent objective that aids in the achievement of the desired effect

Scenarios –

- Traditional challenges are posed by states employing recognized military capabilities and forces in well-understood forms of military competition and conflict;
- Irregular challenges come from those employing unconventional methods to counter the traditional advantages of stronger opponents;
- Catastrophic challenges involve the acquisition, possession, and use of (weapons of mass destruction (WMD) or methods producing WMD like effects;
- Disruptive challenges that may come from adversaries who develop and use breakthrough technologies to negate current U.S. advantages in key operational domains

  (Force Structure, Resources, and Assessments Directorate, 2009, p. 38)

Task – an action or activity (derived from an analysis of the mission and concept of operations) assigned to an individual or organization to provide a capability (Defense Acquistion University, 2011, pp. B-266).

Validation - The review and approval of capability by a designated validation authority. (Joint Capabilities Integration and Development System , 2012, pp. GL-7)

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APPENDIX J. TIM 1 STRATEGIC GUIDANCE HANDOUT

The CCAT CBA analysis team created the TIM 1 strategic guidance handout. This handout was included in the CCAT CBA final report.

Summary of Key US Strategic Documents and Their Relevance to CCATT Mission

OVERVIEW: Force Health Protection Problem Statement
The problem that faces the joint force is to determine how to more effectively provide health protection to a force that will operate in a complex and diverse operational environment; confront a range of traditional and new adversaries and threats; employ and integrate new technologies; and collaborate with other organizations, agencies, nations and cultures. The mission is broad and powerful; "our team provides optimal Health Services in support of our nation's military mission—anytime, anywhere." *FHP CONOPS*

GENERAL SCENARIOS: Enemies and Threats

1. Homeland Issues – Natural Disasters, Illicit Trafficking
2. Asia/Pacific – China, North Korea
3. Middle East - Iran
4. Non-State Actors – Pirates, Terrorists

GEOPOLITICAL CHALLENGES AND RELEVANCE TO CCATT MISSION
Global Trends 2030 Report/National Security Strategy
The geopolitical challenges in the next 15-20 years can have a significant impact on our national interests, National Security Strategy, and how the military will operate in the future. Specifically, these geopolitical challenges could change the role and mission of CCATT; therefore, it is important to determine how the current and future CCATT system will remain resilient against these global trends.

1. **Resource Constraints** – budget, manpower, energy, and basic necessities could be constrained for CCATT, the military, the nation, and the world. Furthermore, the NSS discusses the issues of "rising fiscal and trade deficits," "constrained fossil fuel," "food insecurity," "dangers to public health," and "economic instability" (White House, 2010, p. 1;9).

   Megatrend: "Food, Water, Energy Nexus" – "Demand for these resources will grow substantially owing to an increase in the global population. Tackling problems pertaining to one commodity will be linked to supply and demand for the others" (National Intelligence Council , 2012, p. ii).

Tectonic Shift: "Food and Water Pressures" - Demand for food is expected to rise at least 35 percent by 2030 while demand for water is expected to rise by 40 percent. Nearly half of the world's population will live in areas experiencing severe water stress. Fragile states in Africa and the Middle East are most at risk of experiencing food and water shortages, but China and India are also vulnerable" (National Intelligence Council , 2012, p. v).

Megatrend: "Demographic Patterns" - The demographic arc of instability will narrow. Economic growth might decline in "aging" countries. Sixty percent of the world's population will live in urbanized areas; migration will increase. (National Intelligence Council , 2012, p. ii).

Tectonic Shift: "Unprecedented and Widespread Aging" – "Whereas in 2012 only Japan and Germany have matured beyond a median age of 45 years, most European countries, South Korea, and Taiwan will have entered the post-mature age category by 2030. Migration will become more globalized as both rich and developing countries suffer from workforce shortages (National Intelligence Council , 2012, p. v).

a. **CCATT Relevance**: United States is impacted by constrained resources, which could cause a decrease in military budget, possible manpower shortages for CCATT personnel, influence on mission accomplishment, and potential individual and team performance issues. Our dependency on fossil fuels may reduce mission range, and the role of CCATT (White House, 2010, p. 8).

2. **Partnerships** – there could be a requirement for CCATT to interact and work more closely with NGOs, civilians, international allies, coalitions, etc. Furthermore the NSS discusses "cooperative approaches among nations," and specifically mentions the federal, state, and government agencies working together, the possibility of international coalitions, and "international cooperation" (White House, 2010, pp. 1-3; 8-9)

   a. **Megatrend:** "Diffusion of Power" - "There will not be any hegemonic power. Power will shift to networks and coalitions in a multipolar world" (National Intelligence Council , 2012, p. ii).

   Potential World: "Fusion" – "In the most plausible best-case outcome, China and the US collaborate on a range of issues,

leading to broader global cooperation" (National Intelligence Council , 2012, p. ii).

Potential World: "Non-state World" – "Driven by new technologies, non-state actors take the lead in confronting global challenges" (National Intelligence Council , 2012, p. ii).

Game Changer: "Role of the United States" – Will the US be able to work with new partners to reinvent the international system?

b. **CCATT Relevance**: The CCATT may have more diplomatic and developmental roles/responsibilities to include interagency operations, training and educating other organizations, and multi-coalitions missions.

3. **Performance Implications** – climate change could have operational effects on the CCATT. The NSS specifically discusses climate change.

   a. **Black Swan:** "Much More Rapid Climate Change" – "Dramatic and unforeseen changes already are occurring at a faster rate than expected. Most scientists are not confident of being able to predict such events. Rapid changes in precipitation patterns—such as monsoons in India and the rest of Asia—could sharply disrupt that region's ability to feed its population (National Intelligence Council , 2012, p. xi).

   b. **CCATT Relevance**: The CCATT will have to operate in more extreme and unpredictable environmental conditions. This could impact individual and team performance.

DEFENSE STRATEGIC GUIDANCE (January 2012) AND RELEVANCE TO CCATT MISSION

The following is an overview of the *Global Security Environment* and *Primary Missions of the US Armed Forces* in accordance with the Defense Strategic Guidance.

Global Security Environment

1. Accordingly, while the U.S. military will continue to contribute to security globally, ***we will of necessity rebalance toward the Asia-Pacific region.***
2. The United States will do this while standing up for Israel's security and a comprehensive Middle East peace. ***To support these objectives, the United States will continue to place a premium on U.S. and allied***

military presence in — and support of — partner nations in and around this region.

3. ***In keeping with this evolving strategic landscape, our posture in Europe must also evolve*.** As this occurs, the United States will maintain our Article 5 commitments to allied security and promote enhanced capacity and interoperability for coalition operations. In this resource-constrained era, we will also work with NATO allies to develop a ““Smart Defense”” approach to pool, share, and specialized capabilities as needed to meet 21st century challenges.
4. Across the globe we will seek to be the security partner of choice, pursuing new partnerships with a growing number of nations — including those in Africa and Latin America — whose interests and viewpoints are merging into a common vision of freedom, stability, and prosperity. ***Whenever possible, we will develop innovative, low-cost, and small-footprint approaches to achieve our security objectives, relying on exercises, rotational presence, and advisory capabilities.***
5. **The United States will continue to lead global efforts with capable allies and partners to assure access to and use of the global commons, both by strengthening international norms of responsible behavior and by maintaining relevant and interoperable military capabilities.**

Primary Missions of the US Armed Forces

1. **Counter Terrorism and Irregular Warfare** - Achieving our core goal of disrupting, dismantling, and defeating al-Qa’ida and preventing Afghanistan from ever being a safe haven again will be central to this effort.

   CCATT Relevance Irregular warfare results in irregular injuries in irregular locations

2. **Deter and Defeat Aggression** - Our planning envisages forces that are able to fully deny a capable state’s aggressive objectives in one region by conducting a combined arms campaign across all domains — land, air, maritime, space, and cyberspace. This includes being able to secure territory and populations and facilitate a transition to stable governance on a small scale for a limited period using standing forces and, if necessary, for an extended period with mobilized forces. Even when U.S. forces are committed to a large-scale operation in one region, they will be capable of denying the objectives of — or imposing unacceptable costs on — an

opportunistic aggressor in a second region. U.S. forces will plan to operate whenever possible with allied and coalition forces.

CCATT Relevance Multiple locations puts strain on providers and planning of how to utilize providers.

3. **Project Power Despite Anti-Access/Area Denial Challenges -** States such as China and Iran will continue to pursue asymmetric means to counter our power projection capabilities, while the proliferation of sophisticated weapons and technology will extend to non-state actors as well. Accordingly, the U.S. military will invest as required to ensure its ability to operate effectively in anti-access and area denial (A2/AD) environments.

4. **Counter Weapons of Mass Destruction** - to include preventing Iran's pursuit of a nuclear weapons capability. In partnership with other elements of the U.S. Government, DoD will continue to invest in capabilities to detect, protect against, and respond to WMD use, should preventive measures fail.

   CCATT Relevance CBRNE requirements. Capacity to help more than 6 critical patients.

5. **Operate Effectively in Cyberspace and Space** - Today space systems and their supporting infrastructure face a range of threats that may degrade, disrupt, or destroy assets. Accordingly, DoD will continue to work with domestic and international allies and partners and invest in advanced capabilities to defend its networks, operational capability, and resiliency in cyberspace and space.

   CCATT Relevance Inability to receive Patient Movement Request. Inability to gain patient information.

6. **Maintain a Safe, Secure, and Effective Nuclear Deterrent**

7. **Defend the Homeland and Provide Support to Civil Authorities** - We will also come to the assistance of domestic civil authorities in the event such defense fails or in case of natural disasters, potentially in response to a very significant or even catastrophic event.

   CCATT Relevance Interoperability with non-AF systems. Capacity to help more than 6 critical patients.

8. **Provide a Stabilizing Presence** - A reduction in resources will require innovative and creative solutions to maintain our support for allied and partner interoperability and building partner capacity. However, with reduced resources, thoughtful choices will need to be made regarding the location and frequency of these operations.

9. **Conduct Stability and Counterinsurgency Operations** - Accordingly, U.S. forces will retain and continue to refine the lessons learned, expertise, and specialized capabilities that have been developed over the past ten years of counterinsurgency and stability operations in Iraq and Afghanistan. However, U.S. forces will no longer be sized to conduct large-scale, prolonged stability operations.

   CCATT Relevance Downsizing of force will affect CCATT personnel levels as well.

10. **Conduct Humanitarian, Disaster Relief, and Other Operations** - U.S. forces possess rapidly deployable capabilities, including airlift and sealift, surveillance, medical evacuation and care, and communications that can be invaluable in supplementing lead relief agencies, by extending aid to victims of natural or man-made disasters, both at home and abroad. DoD will continue to develop joint doctrine and military response options to prevent and, if necessary, respond to mass atrocities. U.S. forces will also remain capable of conducting non-combatant evacuation operations for American citizens overseas on an emergency basis.

    CCATT Relevance Reduction of force will affect CCATT; however, they will still be required to conduct humanitarian, disaster relief, and other operations.

MATURE AND EMERGING CHALLENGES AND RELEVANCE TO CCATT MISSION *CBA Guide/FHP CONOPS*

The traditional battlefield has transformed into a diverse and unpredictable environment with disparate threats and methods such as chemical, biological, radiological, and nuclear weapons posed by adversaries who have strong motivation to adopt asymmetric methods to counter US advantage. In addition to traditional capability models, a new array of challenges has emerged:

1. **Traditional -** are posed by the states employing recognized military capabilities and forces in well-understood forms of military competition and conflict.

a. **Enemy** China
b. **Threat** “We will continue to monitor carefully China’s military developments and the implications those developments have on the military balance in the Taiwan Strait. We remain concerned about the extent and strategic intent of China’s military modernization, and its assertiveness in space, cyberspace, in the Yellow Sea, East China Sea, and South China Sea.” *NMS*
c. **CCATT Relevance** PACAF does not typically see combat injuries. Limited locations for staging and treatment.

2. **Irregular** – come from those employing “unconventional” methods to counter traditional advantages of stronger opponents
    a. **Enemy** Terrorists
    b. **Threat** “Readiness – Readiness, too, must remain a top priority, as our forces, systems, and capabilities will continue to be under extraordinary stress. Readiness is the ability to provide and integrate capabilities required by Combatant Commanders to execute their assigned missions. Restoring readiness will help improve our strategic depth to conduct full-spectrum operations, which has been degraded by sustained combat. Short term efforts to improve readiness will focus on resetting equipment and reconstituting units, in some cases--most notably rotational and expeditionary forces--this will be in stride. As we reset, we will conduct more full-spectrum joint, combined, interagency, and multinational training, exercises and experimentation. Forward presence and engagement will take on greater importance during this time. Long-term modernization efforts will improve readiness by developing essential capabilities and capacity to outpace emerging threats. A further degradation of readiness for the full range of military operations would undermine our ability to fulfill our national defense objectives – an unacceptable risk.” *NMS*
    c. **CCATT Relevance** Types of injuries. Locations of injuries across the world.
3. **Catastrophic** – involve acquisition, possession, and use of weapons of mass destruction (WMD) or methods producing WMD-like effects
    a. **Enemy** Iran, Terrorists
    b. **Threat** "We will support efforts to counter transnational and sub-state militant groups, and combat the spread of WMD and related materials. We will maintain an appropriate presence capable of reassuring partners and allies and preventing Iran from acquiring nuclear arms.” *NMS*

c. **CCATT Relevance** CBRNE requirements. Capacity to help more than 6 critical patients.

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a. **Enemy** North Korea, Terrorists
b. **Threat** "In Asia, North Korea's nuclear capability and potentially unstable transition of power poses a risk to regional stability and international non-proliferation efforts." *NMS*
c. **CCATT Relevance** CBRNE requirements. Capacity to help more than 6 critical patients.

---

a. **Enemy** Natural Disasters/Humanitarian Crises
b. **Threat** "The uncertain impact of global climate change combined with increased population centers in or near coastal environments may challenge the ability of weak or developing states to respond to natural disasters." *NMS*

"Humanitarian assistance and disaster relief activities employ the Joint Force to address partner needs and sometimes provide opportunities to build confidence and trust between erstwhile adversaries. They also help us gain and maintain access and relationships that support our broader national interests. We must be prepared to support and facilitate the response of the United States Agency for International Development and other U.S. government agencies' to humanitarian crises." *NMS*

c. **CCATT Relevance** Interoperability with non-AF systems. Capacity to help more than 6 critical patients.

4. **<u>Disruptive</u>** – may come from adversaries who develop and use breakthrough technologies to negate current US advantages in key operational domains
    a. **Enemy** China
    b. **Threat** "We remain concerned about the extent and strategic intent of China's military modernization, and its assertiveness in space, cyberspace, in the Yellow Sea, East China Sea, and South China Sea. To safeguard U.S. and partner nation interests, we will be prepared to demonstrate the will and commit the resources needed to oppose any nation's actions that jeopardize access to and use of the global commons and cyberspace, or that threaten the security of our allies." *NMS*
    c. CCATT Relevance Inability to receive Patient Movement Request Inability to gain patient information.

APPENDIX K. TIM 1 DATA COLLECTION SHEET

The CCAT CBA analysis team created the data collection sheet. This sheet was included in the CCAT CBA final report.

Technical Interchange Meeting (TIM)
Questions for Subject Matter Expert (SME)
In Critical Care Air Transport Team Activities

CCATT Capabilities and Gaps

1. What are the CCATT capabilities needed to accomplish this mission?
2. Does the CCATT system currently have these capabilities? If not, why does the current CCATT system not have these capabilities?
3. Do you think the CCATT system will have these capabilities in the future? If not, what needs to happen in order for the CCATT system to accomplish this mission?
4. Is there anything else you would like to add?

*Additional questions regarding capabilities and gaps may be asked as the interviews and discussions progress. Question not contained on this data collection tool will be within the scope of attached concept map and the scenarios.

CCATT Risks

1. What are the risks associated with these capability gaps?
2. What is the probability and severity of these risks?
3. How do these risks affect the current CCATT mission?
4. How do these risks affect CCATT missions in the future?
5. How would you rank these risks (1 being the most risky, 10 being the least risky)?
6. Do you think these rankings will stay the same in the future? If not, why?
7. How would you prioritize these risks?
8. Is there anything else you would like to add?

*Additional questions regarding risk may be asked as the interviews and discussions progress. Question not contained on this data collection tool will be within the scope of attached concept map and the scenarios.

CCATT Recommendations

1. How should these capability gaps be filled?
2. How can this gap be filled using Doctrinal solution?
3. How can this gap be filled using an Organization solution?
4. How can this gap be filled using a Training solution?
5. How can this gap be filled using a Materiel solution?
6. How can this gap be filled using a Leadership and Education solution?
7. How can this gap be filled using a Personnel solution?
8. How can this gap be filled using a Facilities solution?
9. How can this gap be filled using a Policy solution?
10. What is the most important solution? What solution is needed ASAP?
11. What is the least important solution? What solutions can wait?
12. How would you rank these solutions?
13. Is there anything else you would like to add?

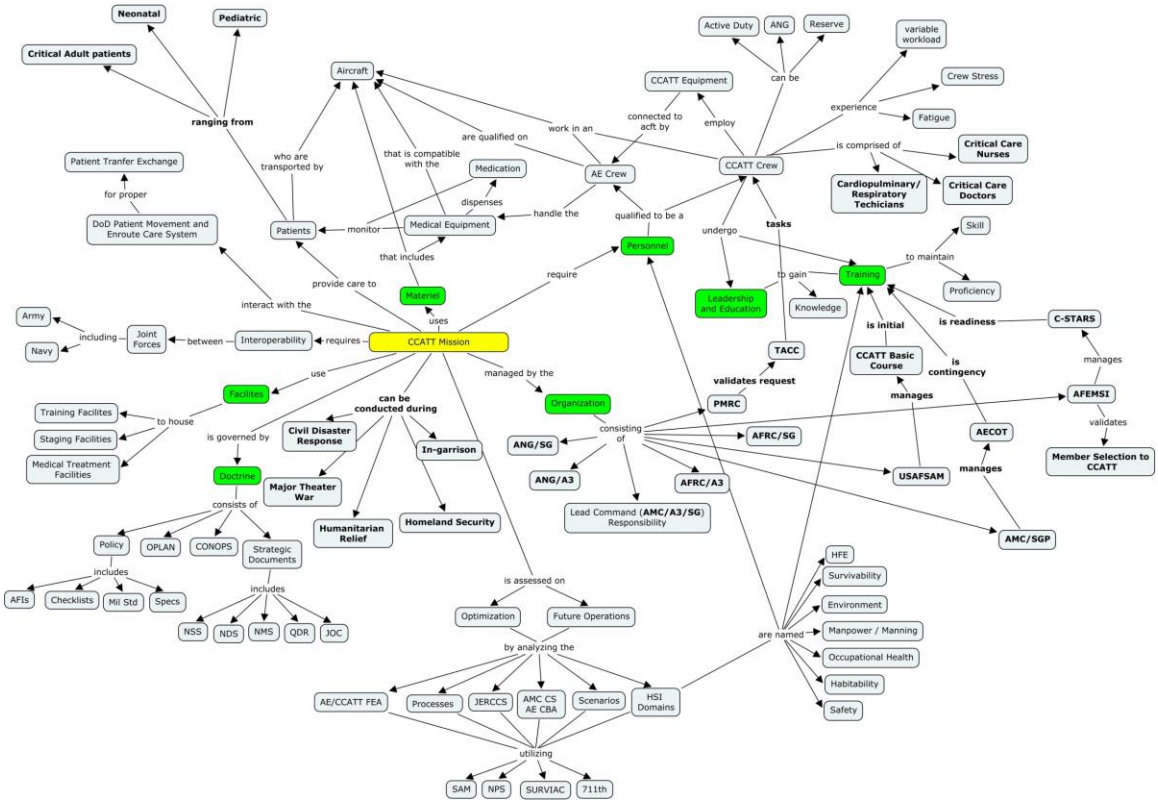
*Additional questions regarding recommendations may be asked as the interviews and discussions progress. Question not contained on this data collection tool will be within the scope of attached concept map and the scenarios.

Critical Care Air Transport Team Data Collection Tool: Validation and Verification

1. Do you agree with these findings? Why or Why not?
2. Are these the capabilities of the current CCATT system?
3. Are there any capabilities that need to be added? Are there any capabilities that need to be deleted? Why?
4. Are these the capability gaps of the current CCATT system?
5. Are there any capability gaps that need to be added? Are there any capability gaps that need to be deleted? Why?
6. Are these the capability gaps of the future CCATT system?
7. Are there any future capability gaps that need to be added? Are there any future capability gaps that need to be deleted? Why?
8. Are these risks to the CCATT mission?
9. Are there any risks that need to be added? Are there any risks that need to be deleted? Why?
10. Are these risk ratings correct? Incorrect? Why?
11. Why do you think these risk ratings need to be changed?
12. Are these the potential recommendations for the CCATT system? Are there any recommendations that need to be added? Are there any recommendations that need to be deleted? Why?

13. Why do you think these recommendations will close the capability gaps?
14. Why do you think these recommendations will not close the capability gaps?
15. Is there anything else you would like to add?

*Additional questions, regarding the validation and verification of the finding or CBA progression, may be asked as the interviews and discussions progress. Question not contained on this data collection tool will be within the scope of the attached concept map and the scenarios.



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APPENDIX L. TIM 1 NOTES

The TIM 1 notes were created by the CCAT CBA analysis team. These notes were included in the CCAT CBA final report.

MEMORANDUM FOR 711 HPW/HP
FROM Naval Post Graduate School (NPS) / SURVIAC
SUBJECT Critical Care Air Transport (CCATT) Capabilities Based Assessment (CBA) Technical Interchange Meeting (TIM), CSTARS tour, and 711 HPW/XR meeting

1. Location: Tec^Edge, Dayton OH; C-STARS Cincinnati, OH; WPAFB, OH
2. Date: 26 February – 1 March 2013
3. Attendees:

Rank	**Organization**		**Rank**	**Organization**
Col	AFRC/A3TM		Maj	HQ AMC/SG
Col	NGB/SG Division		Maj	USAFSAM/ CCATT C-STARS
Col	AFMC USAFSAM/ FECM		Maj	711 HPW/HP
Col	88 SGOS/SGCO		Maj	59th MDW
Col	445 AES		Capt	USAFSAM
Lt Col	711 HPW/HP		LT	NPS
Lt Col	USAFSAM/ CCATT C-STARS		MSgt	USAFSAM/ CCATT
Wg Cmdr	711 HPW/HP		MSgt	NGB (4H FAM)
Lt Col	USAFSAM/ CCATT C-STARS		Dr.	NPS
Lt Col	NGB/SG Division		Dr.	NPS
Lt Col	USAFSAM/ CCATT C-STARS		Mr.	711 HPW/XP
Maj	711 HPW/XR		Ms.	711 HPW/HPO

Rank	Organization		Rank	Organization
Maj	USAFSAM/ ETT		Ms.	SURVIAC

4. Tuesday, 26 February 2013

Topic Presentation

<name removed> presented on Human Systems Integration (HSI) and Capabilities Based Assessments (CBA). He defined HSI and how it crosswalks with the Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, and Facilities (DOTMLPF) construct. He also defined what a CBA is and how it will be used with regards to Critical Care Air Transport (CCAT).

Front End Analysis Overview

<name removed> presented an overview of the AE/CCATT Front End Analysis (FEA) that was conducted in 2012. She discussed the methodology and results, and how the results influenced the undertaking of the CCAT CBA.

Current Capabilities Validation

The group reviewed and validated the current CCAT capabilities that were gathered by the CBA team (see Attachment 1: Current Capabilities).

Generate Future Scenarios

<name removed> discussed US Strategic Documents reviewed for the development of future CCAT scenarios. She explained the megatrends within resource constraints, partnerships, and performance implications and the potential influence on the CCAT mission.

<name removed> discussed the global security environment and the potential future primary missions of the US Armed Forces and their potential influence on the CCAT mission.

<name removed> explained the four types of scenarios to be used to frame the CBA and the capabilities associated with future CCAT missions. The four scenario types were: traditional, irregular, disruptive, and catastrophic. He then led the group in the development of an irregular scenario. The irregular scenario consisted of an embassy in <name removed> being attacked with a bomb. The scenario was used to create the sequence of events for CCAT involvement and to identify the needed capabilities (see Attachment 2: Irregular Scenario).

5. Wednesday, 27 February 2013

Top discussion points from day one:

1. Current capabilities
2. Future capabilities discovered through irregular scenario

Generate Future Scenarios

<name removed> led the group in the development of a catastrophic scenario. The catastrophic scenario consisted of a 9.1 earthquake south of <name removed> which caused a tsunami that devastated the southern portion of <name removed>. US interests were impacted by the tsunami. All DoD installations in the southern region of <name removed> were damaged. This scenario was used to create the sequence of events for CCAT involvement and identify needed capabilities under different circumstances and requirements then the irregular scenario (see Attachment 3: Catastrophic Scenario).

Team Lead led the group in the development of a traditional scenario. The traditional scenario consisted of <name removed> attacking <name removed> with a low yield nuclear bomb. This scenario was used to create the sequence of events for CCAT involvement and identify needed capabilities under different circumstances and requirements then the irregular and catastrophic scenarios (see Attachment 4: Traditional Scenario).

<name removed> led the group in the development of a disruptive scenario. The disruptive scenario consisted of <name removed> attacking <name removed> with air and ground assets. While the rescue effort is underway <name removed> launches a cyber-attack on the DoD computer network crippling the network and VoIP telecommunications. This scenario was used to create the sequence of events for CCAT involvement and identify needed capabilities under different circumstances and requirements then the irregular, catastrophic, and traditional scenarios (see Attachment 5: Disruptive Scenario).

Teleconference

A teleconference was conducted to capture the thoughts of the invited participants that could not attend in person due to travel constraints. The teleconference began with <name removed> briefly discussing HSI and CBAs. He was followed by <name removed> briefly discussing the FEA conducted in 2012, and then <name removed> discussed US Strategic Documents reviewed for the development of future CCAT scenarios. She explained the megatrends within resource constraints, partnerships, and performance implications and the potential influence on the CCAT mission.

<name removed> then explained the four scenarios that were created and the capabilities associated with each. The teleconference attendees concurred on the scenarios and capabilities while also expressing concern over lost communication and training in the future.

6. Thursday, 28 February 2013

The CBA team toured the C-STARS Cincinnati facility and spoke to several members of their staff. The team received an in-depth explanation of the simulation techniques and equipment used to train and validate the students. The team observed a simulation with a CCAT team and was able to gain a better perspective of how a CCAT mission unfolds.

The team was also able to gather some areas of interest from the members of the C-STARS staff. The areas of interest were:

- Interest in improving management skills due to limited number of patients in hospitals
- Interest in how to maximize TCCET training because TCCET are viewed as a CCATT mission when in fact the missions are quite different based on their operational viewpoint. TCCET is tactical level care while CCATT is strategic level care.
- Interest in improving and evaluating individual critical skills.
- Interest in how to gain flying experience prior to deployment. Flying hours are being cut which reduces the opportunity to gain needed flying experience.
- Interest in fatigue and its effect on team performance.
- Interest in the equipment being purchased. The equipment may not be the most appropriate for the field.
- Interest in examining ways to improve the team performance.

7. Friday, 1 March 2013

The CBA team met with representatives from USAFSAM and 711 HPW/XR to discuss the CBA effort and to gain additional perspectives concerning CCAT. During the discussion several connections were made to ongoing research concerning en route care and other strategic councils and groups that are addressing Aeromedical and CCAT concerns.

8. The CCAT CBATIM, CSTARS tour, and 711 HPW/XR meeting gathered new information and identified new capabilities. Thank you for your participation and if you have any questions please feel free to contact myself, <name removed>

Attachment 1: Current Capabilities

CCAT Team Capabilities –

- Apply restraints
- Conduct infection control
- Conduct pain management
- Handle an infusion pump
- Handle blood gas analyzer
- Handle defibrillator
- Handle intracranial pressure monitor
- Handle oxygen analyzer
- Handle physiologic monitor
- Operate oxygen systems
- Operate a ventilator
- Package patients for transport
- Provide Advanced Cardiac Life support (ACLS)
- Provide Advanced Trauma Life Support
- Provide basic hemodynamic monitoring
- Provide basic hemodynamic monitoring
- Provide critical care
- Provide infection control
- Provide intracranial pressure monitoring
- Provide mechanical ventilation
- Recognize aerospace physiology impacts on patients
- Transport blood and blood products
- Transport burn patients
- Transport medical patients
- Transport patients with pulmonary conditions
- Transport trauma patients
- Transport traumatic brain injury patients
- Transport physiological effects of rapid decompression Treat acute respiratory failure
- Treat cardiac disorders
- Treat effects of positive/negative G forces
- Treat effects of pressure change
- Treat hyperventilation
- Treat hypoxia
- Treat mental health disorders
- Treat mission/self-imposed stress
- Treat musculoskeletal disorders
- Treat neurological disorders
- Treat respiratory disorders
- Treat hemorrhagic shock
- Operate on any cargo aircraft

CCAT Patient Isolation Unit Transport Team –

- Transport patients with unknown disease
- Transport patients with viral hemorrhagic fevers
- Transport patients affected by biological attack
- Deploy a portable containment laboratory with rapid diagnostic assays
- Deploy standard clinical laboratory support
- Deploy with 6 to 12 hours notification
- Operate on any cargo or rotary wing aircraft

CCAT Pediatric Extender Team –

- Provide care for patients 3 months to 14 years
- Assess airway and breathing
- Assess airway patency

- Assess breathing
- Assess circulation
- Assess Signs/Symptoms of Severe Respiratory Distress
- Assess of Signs/Symptoms Respiratory Failure Treatment/Management of Respiratory Distress/Respiratory Failure
- Conduct a rapid cardiopulmonary assessment
- Monitor blood pressure
- Monitor mental status/level of acuity
- Monitor respiratory rate
- Monitor skin color
- Monitor urine output
- Monitor vital signs: heart rate
- Package patient for flight
- Identify Special Pediatric Conditions Predisposing a Patient to Cardiopulmonary Arrest
- Treat stresses of flight for pediatric patients
- Operate on any cargo aircraft

CCAT Neonatal Extender Team –

- Provide care for patients birth to 3 months
- Assess airway and breathing
- Assess airway patency
- Assess breathing
- Assess circulation
- Assess Signs/Symptoms of Severe Respiratory Distress
- Assess of Signs/Symptoms Respiratory Failure Treatment/Management of Respiratory Distress/Respiratory Failure
- Conduct a rapid cardiopulmonary assessment
- Monitor blood pressure
- Monitor mental status/level of activity
- Monitor respiratory rate
- Monitor skin color
- Monitor urine output
- Monitor vital signs: heart rate
- Package patient for flight
- Identify Special Pediatric Conditions Predisposing a Patient to Cardiopulmonary Arrest
- Treat stresses of flight for pediatric patients
- Operate on any cargo aircraft

CCAT Acute Lung Rescue Team –

- Provide specialized care to patients experiencing acute respiratory distress syndrome
- Provide specialized care to patients experiencing acute lung injury

Attachment 2: Irregular Scenario

Situation: In 2028, Embassy in <name removed> **attacked with a bomb**

- Hostages
- Nearest airport is 25 minutes away (international on the coast)
- Casualties (burn and blast):
    - 300 injured
    - 75 CCAT
- Naval presence nearby
- Security is provided
- Host nation capability minimal
- Military capabilities w/n area
- Little to no US military presence in AO
- NGOs present
- SOF in AO

Sequence of Events:

- Diplomatic Request from State Department needed (thru EUCOM)
- Phone call to USAFE
    - Response team
    - NEO
- Contact AOC
- Multiple CCAT teams which includes AE teams
    - Notified
    - Report to MTF
    - Draw medications
        - Responding from multiple locations
- International CCAT teams
- Coordinate
    - Get to airfield
    - Wait for aircraft
    - Aircraft arrives
    - Load aircraft
        - Get gear set up
        - Running scenarios
        - Configure aircraft
        - Rest
        - Get SITREPs
- Evacuate US personnel first
- LNO Team on ground
- Flexibility/Adaptability
- Coordinate w/Ground LNO (priorities)
- Load # CCAT patients
- Refueling
- Fly to Landstuhl
    - Resuscitation
    - Lines
    - Chest tubes
    - Ultrasound
    - Call ahead to Landstuhl
- Transport patients to hospital (O2)
- CCAT follows patient to hospital
- Recover equip
- Clean
- Paperwork
- Stand down/quick turn

Capabilities: (o) = organic / (s) = supporting

- (o) Charging gear en route
- (o/s) O2 generation
- (o/s) Training proficiency
- (o/s) Blood – transport(o)/ obtain (s)
- (s) Real-time info
- (s) Security
- (s) Medical LNO

- (o) “Full-spectrum” critical care exposure
- (o) Maintaining proficiency in peacetime
- (s) Provide real-time update in flight
- (s) Common standard/equipment
- (s) Formal tracking of CCAT trained personnel
- (s) Coordinate international agreements
- (o) Coordinate local support for CCAT
- (s) Obtain VISAs
- (s) Transportation (of equipment)
- (s) Universal power capability
- Standardization/Automaticity
- CRM
- Telemedicine
- Real-time physiologic data gathering
- Resupply
- Documentation (charting) seamless
- Tracking CCATT equipment
- Interpreters for crew in a country that does not speak English
-

Attachment 3: Catastrophic Scenario

Situation: In 2020, Earthquake causes tsunami in Southern region of <name removed>

- All US bases located in southern <name removed> affected
- Initial reports say several thousand dead or injured (US personnel and locals)
- No runways available
- Rotary and Tilt aircraft available and can land in all landing zones

Sequence of Events:

- Diplomatic Request from State Dept. needed (thru EUCOM)
- PACOM responsible
- Clean water and food
- Public health personnel
- Disaster Response (initially)
- National Defense Medical Service
- <name removed> or turn-key in <name removed>
- Transport start Day 4 to Day 10
- TCCET – tactical CCAT
- Local Disaster Teams conduct triage
- Standup a JAOC with representatives to coordinate their participation

Capabilities:

- Biomedical equipment technician (BMETs) – repair and calibration of equipment
- Resupply for TCCET
- Communication
- Resupply for CCAT
- Short multiple missions
- JAOC (international coordination)
- International TCCET type assistance
- Ability to setup on any transport platform (US/International)
- Equipment interoperability
    - Oxygen
    - Electricity
- (o) Charging gear en route
- (o/s) O2 generation
- (o/s) Training proficiency
- (o/s) Blood – transport(o)/
- (s) Security
- (s) Medical LNO
- (o) "Full-spectrum" critical care exposure
- (o) Maintaining proficiency in peacetime
- (s) Common standard/equipment
- (s) Formal tracking of CCAT trained personnel
- (s) Coordinate international agreements
- (o) Coordinate local support for CCAT
- (s) Transportation (of equipment)
- (s) Universal power capability
- Standardization/Automaticity
- CRM
- Telemedicine
- Real-time physiologic data gathering
- Resupply
- Documentation (charting) seamless
- Tracking CCATT equipment

Attachment 4: Traditional Scenario

Situation: In 2025, <name removed> **attacks** <name removed> **with a low yield nuclear bomb**

- Numerous dead, injured, and contaminated
- Northern runway available – southern base attacked
- Summer

Sequence of Events:

- AFSOC teams would be the first ones in b/c they are trained to handle out of the norm scenarios
- Point of injury
    - Army Medic CBRNE teams triage
    - Decontaminate patients
    - Comfort team
    - Ventilator patients expectant
- Army LNO - sets up initial lines of communication
- Transport to clean zone
- CCATT patients w/peripheral exposure
- No TTP exists
- Decon -> "check them" ->redline-> "check again" -> CCAT
  2nd Attack – no ground base resources
- Use of Navy (stairs cause issues)
    - Patient
- EMEDs going into <name removed>
- Army taking the lead of CBRNE needs
- **Capabilities:**
- Ability to operate in any transport vehicle
- Knowledge and treatment of nuclear contamination
- Mobilization of CCAT during wartime (nearby/state side)
- Access to pre-planning documents
- CCAT specific pre-planning documents
- Security of the contaminated zone
- Just in time training
- Staging in expeditionary environment
- Delayed requirements for ventilator Chemical – could overwhelm system if patients require more ventilators or pieces of equipment than exist

Biological – no role unless unintentional exposure
Nuclear – minimal risk because decon will occur prior to treatment

Attachment 5: Disruptive Scenario

Situation: In 2017, <name removed> **attacks** <name removed> **with air and ground assets. Simultaneously** <name removed> **launches a cyber-attack on DoD computer network (worm introduced into system).**

- DoD computer network is virtually crippled. Subsequently, all VoIP telecommunications are crippled.
- <name removed> has suffered damage and injuries and has requested immediate aid from US

Sequence of Events:

- Phone call to USAFE
- Contact AOC
- CCAT
- Coordinate
    - Aircraft arrives
- Fly to <name removed>
    - Get gear set up
    - Running Scenarios
    - Configure aircraft
    - Rest
    - Get SITREPS
- LNO team on the ground

Capabilities:

- System Redundancy
- Ability to track resupply
- Ability to supply orders
- Flexibility at the administration level

Other possible disruptions:

- Fuel
- GPS
- EMP

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APPENDIX M. PRELIMINARY GAP ANALYSIS

The CCAT CBA analysis team created the preliminary gap analysis table.

Gap 0	Gap 1	Gap 2	Gap 3	Gap 4	Gap 5
1.2.5	5.10.1	5.10.3	6.1.7	5.9.1	4.1.1
1.1.3	5.10.2	5.3.1	5.9.2	5.7.5	6.1.1
1.2.7	2.6.1	5.9.3	6.1.8	6.1.2	7.4.1
5.8.5	2.6.2	5.10.4	1.1.1	2.2.1	7.1.1
6.1.14	1.3.2	7.1.8	5.7.6	5.3.2	8.2.1
5.1.1	5.7.2	5.7.7	5.9.4	4.1.2	7.1.2
2.1.5	5.7.3	5.5.2	6.1.3	5.8.1	2.2.3
1.2.8	6.1.9	6.1.10	7.3.4	3.1.1	6.1.5
3.2.7	7.4.2	2.1.1	5.8.2	6.1.4	8.1.1
3.2.10	1.3.1	1.2.1	5.7.1	3.2.1	7.1.4
3.2.8	4.1.3	1.2.2	1.1.2	5.5.1	8.2.2
3.2.9	6.1.12	5.9.5	5.7.11	7.1.3	8.2.3
2.2.5	1.2.3	6.1.11	7.1.5	5.7.9	5.11.1
5.7.18	1.2.4	8.2.6	7.3.3	5.10.5	7.3.1
5.7.19	5.8.3	2.2.2	7.1.7	7.3.2	8.2.4
5.5.3	1.2.6	5.7.13	5.11.2	3.1.2	2.4.1
6.1.20	4.3.1	5.12.1	4.2.1	2.1.4	2.1.2
6.1.21	8.1.3	3.2.3	4.4.1	5.7.8	2.3.1
2.2.6	7.2.1	5.7.4	5.7.12	7.1.6	2.3.3
1.2.9	5.3.6	2.5.1	6.1.6	5.7.10	2.4.2
2.2.7	5.10.7	1.4.1	2.5.2	5.3.3	2.3.2
1.1.4	5.10.8	4.2.2	2.5.3	2.1.8	
2.2.8	5.9.6	5.3.5	3.2.2	6.1.16	
2.2.9	1.3.3	1.4.2	3.2.4	7.4.5	
	5.3.7	2.2.4	8.2.5		
	2.1.11	5.10.6	5.11.3		
	2.1.12	5.8.4	2.6.3		
	5.10.9	3.2.5	6.1.13		
	5.7.20	2.1.3	7.4.3		
	6.1.18	5.6.1	3.2.6		
	6.1.19	8.2.7	8.1.2		
	5.4.1	5.7.14	5.7.15		
	5.4.2	5.3.4	2.1.7		
		1.4.3	6.1.15		
		2.1.10	7.4.4		
		2.1.9	6.1.17		
		1.3.4	7.4.6		
		5.2.1			
		5.7.16			
		7.1.9			
		2.1.6			
		5.7.17			
		5.7.21			
		1.4.4			

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APPENDIX N. TIM 2 NOTES

The TIM 2 notes were created by the CCAT CBA analysis team. These notes were included in the CCAT CBA final report.

MEMORANDUM FOR 711 HPW/HP
FROM Naval Post Graduate School (NPS) / SURVIAC
SUBJECT Critical Care Air Transport (CCATT) Capabilities Based Assessment (CBA) Technical Interchange Meeting (TIM) #2,

1. Location: Tec^Edge, Dayton OH
2. Date: 18 – 19 June 2013
3. Attendees:

Rank	**Organization**		**Rank**	**Organization**
Lt Col	USAFSAM/ FHC		LT	NPS
Lt Col	HQ AMC/SGK		Lt	711HPW/HP
Lt Col	HQ AMC/SG		TSgt	USAFSAM
Lt Col	USAFSAM/ CCATT C-STARS		Dr.	USAFSAM
Wg Cmdr	711 HPW/HP		Dr.	NPS
Lt Col	USAFSAM/ CCATT C-STARS		Dr.	NPS
Lt Col	NGB/SG Division		Mr.	711 HPW/HP
Maj	711 HPW/XPH		Ms.	711 HPW/HP
Maj	711 HPW/HP		Ms.	711 HPW/HP
Capt	USAFSAM		Ms.	SURVIAC
Capt	711 HPW/XPH			

9. Tuesday, 18 June 2013

Topic Presentation

<name removed> presented on Human Systems Integration (HSI) and Capabilities Based Assessments (CBA). He defined HSI and how it crosswalks with the Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, and Facilities (DOTMLPF) construct. He provided an update on what has been accomplished to date and the expectations for this TIM.

Future Scenario Validation

The larger group of 21 attendees was split into two groups in order to discuss and validate the future scenarios created by the CBA team. <name removed> and <name removed> discussed and updated the Traditional (see Attachment 1: Traditional Scenario) scenario while <name removed> and <name removed> discussed and updated the Disruptive (see Attachment 2: Disruptive Scenario) scenario.

Capabilities/Functions/Tasks Validation

The two groups reviewed, validated, and updated the CCAT capabilities that were gathered by the CBA team in the form of a concept map (see Attachment 4: Capabilities CMAP). Each group utilized the scenarios to step through the concept map. At the conclusion of Day One only one scenario had been evaluated against the concept map.

10. Wednesday, 19 June 2013

Continued Future Scenario Validation

Again, the larger group of 21 attendees was split into the same two groups as Day One in order to discuss and validate the future scenarios created by the CBA team. <name removed> and <name removed> discussed and updated the Irregular (see Attachment 3: Irregular Scenario) scenario while Dr. <name removed> and <name removed> discussed and updated the Catastrophic (see Attachment 4: Catastrophic Scenario) scenario.

Continued Capabilities/Functions/Tasks Validation

The two groups continued to review, validate, and update the CCAT capabilities that were gathered by the CBA team in the form of a concept map. Each group utilized the scenarios to step through the concept map. At the conclusion of Day Two all scenarios and capabilities had been evaluated.

Capability Gap Evaluation

<name removed> walked the larger group of 21 attendees through a gap analysis that rated each task on a scale of 0 – 5. If the task was rated a 0 it meant there was no gap. If the task was rated a 5 it meant there was a huge gap. These ratings are included on the Capabilities CMAP.

Teleconference

A teleconference was conducted to capture the thoughts of the invited participants that could not attend in person due to travel constraints. The teleconference began <name removed> briefly discussing what we had accomplished over the previous two days. <name removed> then walked through the Capabilities CMAP. The teleconference attendees suggested changes to multiple ratings, additional tasks, and provided concurrence on majority of the tasks and ratings.

11. Discussion items from 18-19 June

Several suggestions were provided throughout the course of the TIM. The suggestions are listed below:

- Consider adding additional levels to the concept map concerning level of participation of stakeholders
- Include definitions of terminology used. For example: interoperability, deployment, mission, tactical, alert, operational, monitoring, and interchangeable.
- Provide a concept map of organizations and stakeholders that affect the CCAT mission
- Explore ways of showing relationships between capabilities/functions/tasks on the concept map
- Explore how CCAT taskings are handed down through different components (AD, ANG, AFRC)
- Incorporate ways to consider resilience in training. Younger participants are not familiar with non-electronic ways of accomplishing mission; however, CCAT personnel are trained to not trust paperwork
- Ideal situation would cut out the middle man in communication to MTF, staging facility, etc.
- There is a difference between ANG and AFRC Respiratory Technicians (RTs) and AD. AD RTs have a combined field of cardiopulmonary and respiratory technicians while in the civilian sector these are two different fields with no overlap.
- Not every mission/location is the same. There are instances of MTFs not supporting transportation, blood draws, medications, etc.
- There needs to be a means for gathering lessons learned from past conflicts and AARs
- Clinical Practice Guidelines (CPGs) need to be developed, updated, and disseminated
- Utilize same verbiage as the AFMS Strategic Guidance
- CCAT needs to have representation in the acquisition process
- FDA approval takes an extensive amount of time
- Partnerships with civilian hospitals need to be renewed and expanded

- Strategic communication is in need of review
- Explore the role of CCAT Consultant
- Explore validation of CCAT instructors in peacetime
- Skill Retention Dataset does not exist – cannot answer "what does it take to be medically proficient" and there is no model of decay being used
- Create an interactive CBT of equipment
- Explore the creation of a recruiting program for CCAT
- CSTARS is a validation platform. There is no "training" only platform
- Tracking is being done at lower levels. There is no standardization at lower level and higher levels do not have access to this information (they rely on the bottom levels to keep track of this data)
- Explore the creation of CCAT identifiers
- Understand Nurse promotions and CCAT's effect on promotion

12. The CCAT CBA TIM #2 meeting gathered new information and identified new capabilities. Thank you for your participation and if you have any questions please feel free to contact myself, <name removed>.

APPENDIX O. FINALIZED FUTURE SCENARIOS

The CCAT CBA analysis team created the future scenarios. These scenarios were included in the CCAT CBA final report

Critical Care Air Transport (CCAT)

Capabilities Based Assessment:

Scenarios

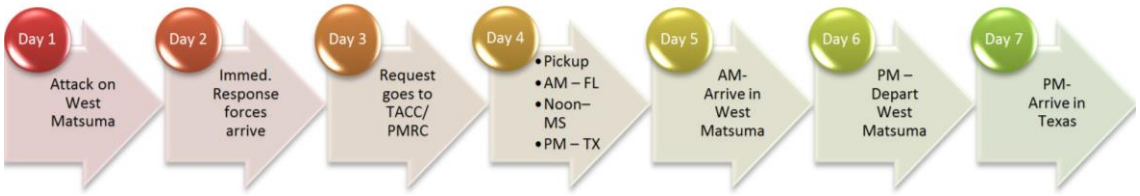
Traditional Scenario

Issues:
Logistics (equipment), Communication flow between AE, CCAT, and Hospital, Training, Team Formation, Fatigue

ASSUMPTIONS

- Iraq/Afghanistan Wars ended in 2015
- The immediacy of the situation did not allow for individuals to fly commercially to one location. An AF plane was the most expedient to get the teams together.
- The mission is round trip from Texas to South America and back
- Two AE crews, two flight crews, and two CCAT teams were needed to conduct the mission
- This scenario only focuses on the experience of one of the CCAT teams
- No extra equipment from allowance standard was taken (only extra disposable items were taken)
- Future tasking relationship from AD, ANG, AFRC is different than system in place today
- Airfield is not a "hot" zone and is not contaminated
- Patients are decontaminated

TIMELINE OF EVENTS



CCAT SITUATION

In 2028, the composition of the Critical Care Air Transport (CCAT) team has remained unchanged. However, the locations from where they would deploy and the number of teams available have changed. Since the United States (U.S.) ended war in Afghanistan, it has been continually reducing its military medical presence around the globe. As a

result there are only five Aeromedical Evacuation (AE) crews and two CCAT teams located in Germany, five AE crews and two CCAT teams in Japan, and two AE crews and one CCAT team in Greenland. All other AE and CCAT Unit Type Codes (UTCs) are located at Medical Treatment Facilities (MTFs) in the U.S.

Each CCAT team is made up of one critical care physician, one critical care nurse, and one respiratory therapist. CCAT personnel backgrounds (*for this scenario*):

Lt Col Josephine Blue – Anesthesiologist – Lt Col Blue has been a USAF physician for 22 years. She graduated from Johns Hopkins and chose to enter the military to pay off her student loans. However, her skills were needed immediately to support the Critical Care mission during wars in Iraq and Afghanistan, and she quickly grew to love the CCAT mission. She has rotated in and out of CCAT four times throughout her career. Although the CCAT mission has taken a toll on her over the years, both physically and psychologically, when she was not on a CCAT team she missed being able to help critically injured Warfighters. She dislikes the administrative parts of management and is ecstatic to be back in on a CCAT team after eight years of running Intensive Care Units (ICUs) with few patients. She has been in Florida for two years.

Maj Caroline Green – Critical Care Nurse – Maj Green has been a nurse for 12 years. She has spent most of her time in MTF ICUs. She has never been part of AE or CCAT, and has limited experience with trauma injuries. Her daily responsibilities consist of caring for one or two intubated patients recovering from surgery. She grew up in Mississippi so she was excited to move back to her home state. She arrived in Mississippi two weeks ago, has completed in-processing, and was just informed of her appointment to the CCAT team.

MSgt Bill Boyle – Respiratory Therapist – MSgt Boyle has been in the AF Reserve for 12 years. He has been a fast burner and has made rank the first time every time. He is extremely confident in his skills and volunteered to be on a CCAT team.

GENERAL SITUATION

By 2025, the global population has continued to grow steadily, putting a strain on natural resources. Countries are continuing to fight over aquifer and oil rights. The most recent hotspot involves the South American nations of East Matsuma and West Matsuma. Following the Matsuman national revolution in 2018, the United Nations (UN) was able to broker a settlement in which the country was divided into what appeared at the time to be two separate but relatively equal nations. West Matsuma remained democratic and a

strong ally of the United States (U.S.) and many other freedom-loving nations. East Matsuma, influenced by the support received from Cuba during the revolution, embraced socialism.

In 2021, a large and easily accessible oil field was discovered under West Matsuma. The country quickly tapped the oil and benefitted greatly from its sale. Between 2021 and 2028 the West Matsuman economy flourished in every respect. In East Matsuma, however, the regime controlled and oppressed its people to the point where members of the UN voted overwhelming to condemn the country's leaders and to issue severe trade embargos. With only Cuba's support and its own dwindling resources available, by 2028 East Matsuma has become a third-world nation with the exception of its military. East Matsuma maintains the fifth largest Army in the southern hemisphere. All of the country's financial resources are given to the Army. Its people are suffering while the Army remains strong. However, even the Army is beginning to feel the stress of reduced natural resources.

East Matsuma has become increasingly envious of the recently discovered natural resources in West Matsuma. As a result, the rhetoric and skirmishes between East and West Matsuma have escalated significantly over the last several months. East Matsuma would have already attacked West Matsuma if it had not been for the strong U.S. military presence in that nation. Recent intelligence reports have confirmed that East Matsuma has developed both biological and chemical weapons and has the ability to deliver them into West Matsuma.

INITIAL SITUATION

Over the past six months East Matsuma has increased its threats and across border skirmishes against West Matsuma. Attacks on military outposts that protect key water purification centers and aquifer wells occur weekly; however, West Matsuma has been able to withstand all attacks. West Matsuma's ability to remain strong in spite of the continuous attacks has angered East Matsuma to the point of threatening chemical agent attack.

Two months ago West Matsuma and the U.S. conducted a Joint exercise. The alliance exercised scenarios concerning protection of the aquifer as well as potential chemical attack with limited lead time.

One month ago, intelligence reported that East Matsuma conducted a military exercise in which a missile with a warhead that appeared to contain a spraying mechanism was conducted in one of East Matsuma's missile ranges. Intelligence also reported a smoke like substance emitting from the warhead; however, the substance could not be confirmed

to be coming from the warhead as a dispersed agent or if the missile was malfunctioning as it neared impact. This exercise appeared to be in response to the Joint exercise conducted one month prior.

Two days after East Matsuma demanded West Matsuma provide "unlimited access to one of its aquifers or else", it attacked West Matsuma's largest aquifer located within 75 miles of the border with a non-persistent chemical agent delivered by missile.

Immediately following the chemical attack East Matsuma attacked with ground forces attempting to take over the aquifer.

The U.S. and West Matsuma military personnel were able to avoid debilitating symptoms of the chemical attack by the use of their chemical protection equipment. The military's ability to hold its lines and keep East Matsuma at bay allowed for continued operation of the aquifer.

While West Matsuma's military prevailed relatively unscathed by the chemical attack, the civilian population of the city of Ollech located near the aquifer was severely impacted by the chemical attack. Reports showed that the attack was not expected to impact the city; however, due to wind direction and the missile landing further South than expected thousands were affected.

Thousands of civilians suffered mild to severe reactions to the agent. The affected were West Matsuma nationals as well as U.S. citizens. The number of affected quickly overwhelmed the medical response teams. A request was made to the nearby U.S. Joint Base for any and all medical transport to help save the lives of those with respiratory issues, pediatric, and geriatric patients.

The initial response teams were specially trained Air Force Special Operations Command (AFSOC) personnel who specialize in abnormal military situations, Army chemical, biological, radiological, and nuclear (CBRN) teams, and UN/coalition forces that had been stationed at the Joint Base due to the threat of chemical agent attack by East Matsuma. The AFSOC and Army teams provided point of injury care to include triaging patients, decontaminating patients for residual chemical agent, and providing comfort to patients.

The Army liaison team set up initial lines of communication to Tanker Airlift Control Center (TACC) and the Patient Movement Request Center (PMRC) in order to request AE and CCAT.

Because the agent used was non-persistent the teams were able to decontaminate patients quickly and transport them to the airfield which was designated a clean zone.

CCAT INVOLVEMENT

Following the notification by the PMRC and TACC, the Air Operations Center began the official designation of AE and CCAT teams. Following the designation of available CCAT members, each member was notified of their immediate deployment. TACC arranged for a C-17 to depart Florida with an AE crew and Lt Col Blue. The aircraft then picked up Maj Green from Mississippi and proceeded to Texas to pick up MSgt Boyle. MSgt Boyle was notified for a last minute tasking. He was told that the Respiratory Therapist that was originally on alert broke their ankle while running, and could not fill the tasking. He was the most qualified person to fill the vacancy. MSgt Boyle is excited to go and sees this as an opportunity to showcase his skills and experience gained while working at the local community trauma center. He had to quickly arrange for someone to cover his shifts at the hospital. His employer was not pleased with the last minute deployment, but was able to re-arrange the schedule to allow him to go. While the aircraft was enroute from Florida to Texas, MSgt Boyle was directed to go to the MTF to draw medications and collect all needed equipment. This was an abnormal situation because the CCAT team was gathering from multiple stateside locations. Typically, the team arrives and picks up their equipment from the MTF; however, in this situation three strangers are gathering to conduct a mission. Lt Col Blue (Florida) and Maj Green (Mississippi) each put together their own "go bag" prior to leaving their base. They pulled general equipment from their base's CCAT equipment bags to ensure they had the equipment they typically like to use. They did not trust that MSgt Boyle would get the proper equipment. They also did not "check" this equipment out of the bags, because "go bags" are not standard procedure.

MSgt Boyle gathered the appropriate medication and equipment from Texas' MTF. He was bused to the airfield in order to load the C-17. The aircraft was chosen on an availability and capability basis and could have been a C-17, C-130, or a KC-135. *(In this scenario the aircraft was a C-17.) (Each aircraft requires a different setup and configuration.)*

This mission was a round trip flight from Texas to West Matsuma lasting in excess of 24 hours. It required extra personnel to ensure crew rest requirements were met, and an in-flight refueling. During the flight to West Matsuma, the AE crew began to configure the aircraft to support their mission. During the flight the teams ensured the equipment was setup correctly, ran through possible scenarios they would encounter, rested, got to know each other, and reviewed Situation Reports (SITREPs).

It was obvious to the team that they did not know each other, and had limited time to gain a cohesive unit. Lt Col Blue had CCAT experience and knew the right questions to ask

her team. They spent the first few hours of the flight gaining an understanding of each other's experience level with regards to patient care and CCAT. They also shared what they felt were their strengths and weaknesses. They all agreed that they did not feel prepared to handle a chemical attack. It has been several months since they had completed the computer based training concerning chemical injuries, and had no hands on experience with patients with these types of injuries. Due to the reduced size of military MTFs and reduced acuity of patients their clinical skills were not where they wanted them to be, but felt even less prepared for the types of injuries that resulted from chemicals. Lt Col Blue had her iPad with cellular connection so the team researched techniques for handling chemical related injuries.

When they felt they knew enough about each other, they decided to try and sleep. All had been awake for 8 hours working at their local MTF/hospital in addition to the preparation time for their flight. They were able to rest for 6 hours; however, they did not obtain quality sleep. When they were within two hours of their arrival time the team began running scenarios.

The scenarios encompassed such things as: types of injuries (airway irritation, chest tightness, bronchospasm), barriers they may face (language, nationality, etc.), and support available (liaison teams, non-government organizations, international aid). The SITREPs provided by the pilots formed the basis for each injury in the scenario. The team used the iPad to help them navigate the injuries that were being reported.

As they got closer to the clean zone, the AE crew received unconfirmed reports of the number of injured and critical patients. The information was not guaranteed to be 100% accurate, but did allow the team to mentally prepare for what they would face.

The Concept of Operations concerning attacks on U.S. civilians called for the evacuation of affected U.S. citizens first. This required coordination with ground liaison teams and ground medics to determine who of the critical patients were U.S. citizens.

Due to the number of critical patients, the international community was needed to support the evacuation effort. This required coordination between the teams and the commanding organizations as well as the forces on the ground.

The situation on the ground was not completely under control and the CCAT team had to be flexible in order to accept patients not originally on the manifest. They also had to adjust their aircraft configuration to accommodate patients whose status changed while the team was in flight.

Due to the extra AE crew and CCAT team, AE was only able to carry 30 patients. Then the CCAT team loaded 4 high-acuity patients and departed for the return trip to Texas.

While in flight the CCAT team worked to stabilize their patients. The first patient was a pre-teen girl who suffered from asthma who was playing at the park. The second patient was the pre-teens mother who suffered a reaction to the chemical used in the attacks. She had burns on her exposed skin, and windpipe from the chemical. The third was an elderly man who suffered from COPD, and the fourth was a power station operator who fell from scaffolding during the attack. He broke his back, suffered from a head injury, and was mildly affected by the chemical.

Three patients had to be intubated on ventilators to keep their respiratory systems from collapsing. The fourth was anesthetized and immobilized due to his injuries. While in flight three of the AE patients' ability to breathe decreased rapidly. The Medical Crew Director (MCD) requested a consult from Lt Col Blue. There was some miscommunication concerning the patient's symptoms and medications the patient had been prescribed due to aircraft noise. Lt Col Blue and the MCD were able to work out the details and treat the patients appropriately. The CCAT team had to administer medication to two patients, and to provide oxygen to the third.

Before the aircraft arrived in Texas, the AE crew had to relay the critical patient status to the Medical Facility. The number of critical patients went from 4 to 5 with two stabilized with medication.

Once the aircraft arrived at the airfield, the critical patients were off-loaded first. The CCAT team transported their patients (to include the AE patient) to the MTF where they conducted a handoff to critical care providers.

During patient handoff, CCAT members recovered their equipment. This required all equipment to be removed from the patients and new equipment to be put on the patients. All equipment was sanitized prior to reuse.

All medical reporting was accomplished post mission. All medication used, equipment used, patient status throughout the flight, and any other pertinent details was captured. Following these actions the CCAT team was told to check into a local hotel with the flight and AE crews in order to rest and recuperate. It was unknown whether they would make a return trip to West Matsuma the following day.

Irregular Scenario

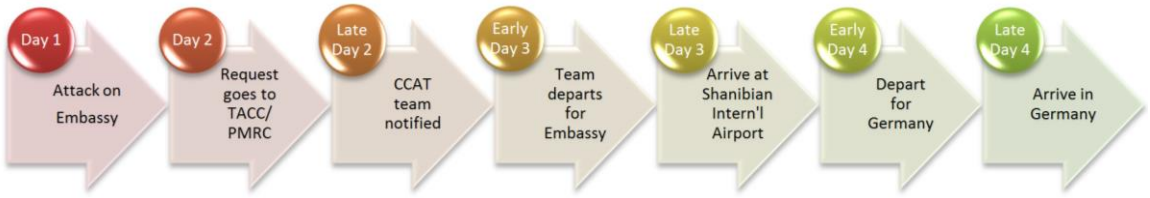
Issues:

Fatigue, CRM, PTSD, Team formation, Communication between AE, CCAT, and Hospital

ASSUMPTIONS

- Iraq/Afghanistan Wars ended in 2015
- Helicopters are available to transport patients to the airfield
- Airfield is not a "hot" zone
- Two AE crews, two flight crews, and two CCAT teams were needed to conduct the mission
- This scenario only focuses on the experience of one of the CCAT teams
- No extra equipment from allowance standard was taken (only extra disposable items were taken)
- Future tasking relationship from AD, ANG, AFRC is different than system in place today

TIMELINE OF EVENTS



CCATT SITUATION

In 2028, the composition of the Critical Care Air Transport (CCAT) team has remained unchanged. However, the locations from where they would deploy and the number of teams available have changed. Since the United States (U.S.) ended war in Afghanistan, it has been continually reducing its military medical presence around the globe. As a result there are only five Aeromedical Evacuation (AE) crews and two CCAT teams located in Germany.

The CCAT teams in Germany are made up of two critical care physicians (one pulmonary/critical care physician and one Anesthesiologist), two critical care nurses, and two respiratory therapists. CCAT personnel backgrounds (*for this scenario*):

Lt Col John Potter - Pulmonary/Critical Care Physician – Lt Col Potter has been a physician for 13 years. Prior to becoming a physician he was an enlisted Air Force medic. He entered the military after high school in 1998 and quickly became a top notch performer in a Medical Treatment Facility. He deployed several times as a member of the AE crews in Pacific Air Force (PACAF), shuttling patients from Japan to the states for treatment. After the attacks of 9/11, he transported many patients from Iraq and Afghanistan as an AE crewmember. He decided he wanted to do more. He separated from the AF in 2005, attended college, and completed his medical education and training in 2015. He rejoined the Air National Guard (ANG) as a physician in 2015. He volunteered to be a member of CCAT because he wanted to help Warfighters who have been critically injured. He has been in Germany for two months. Lt Col Potter is nearing the end of his mobilization and is expecting his replacement any day. He has a medical practice to return to and is already in transition mode.

Maj Jack White – Critical Care Nurse – Maj White has been in the AF for 18 years and was in CCAT at the end of the Iraq and Afghanistan wars. He grew to hate CCAT not because of the mission, but because of management challenges. He suffered from undiagnosed symptoms consisting of post-traumatic stress disorder (PTSD) for several years following his last deployment to Afghanistan. He saw horrific injuries to young men and women who were flown back home. He was affected by the injuries of the Warfighters and the emotional toll it took on their families. He thought he would never have to be on CCAT again until he moved to Germany. When his leadership heard he had CCAT experience they placed him in an open CCAT billet. He protested but with no success. His only solace was that there had not been a major conflict for several years. He has been in Germany for 1 year.

TSgt Mary Black – Respiratory Therapist – TSgt Black has been in the military for 10 years. She has limited experience working with patients. She worked as a desk clerk in her first assignment because of manning shortages. She then worked in a clinic and assisted with routine patients. She tested well and made SSgt. She was reassigned to the school house and taught technical school for young Airmen. Eventually, she made TSgt and received orders to Germany. They needed to fill the CCAT position so they placed her in the slot and sent her to training. Her leadership was able to waive the 800 hour requirement, because of her teaching experience. She graduated by accomplishing the minimum requirements. She has

been in Germany for 8 months but has spent most of the time at Non-Commissioned Officer (NCO) Academy and CCAT training back in the U.S.

GENERAL SITUATION

By 2028, the U.S. has increased the number of embassies it maintains around the world. The U.S. has expanded its global reach by placing an embassy in the West African country of Shanibia. While the Shanibian government welcomes the U.S., there are still factions within the country that do not welcome the western nation's presence. The most out spoken group against the U.S. embassy is the Shanibian People's Revolution Army (SPRA).

INITIAL SITUATION

Over the past three years the SPRA has made verbal threats against the U.S., but has never acted upon those threats. Over the past four months the U.S. and Shanibia have worked to increase U.S. foreign aid and establish more schools and hospitals staffed primarily with U.S. aid workers. This new agreement enraged the SPRA. The SPRA has increased its threats against the U.S. stating that "when the first group of aid workers arrives, an attack unlike any other will occur. To avoid such a travesty the U.S. should not follow through with the agreement." The U.S. position is that it does not negotiate with terrorists nor respond to threats and has pressed forward with plans to establish the new schools and hospitals.

One week after the aid workers arrived in Shanibia, the U.S. embassy was attacked with several small bombs placed around the complex. The bombs detonated intermittently causing chaos that enabled members of the SPRA to breach the walls and enter the complex. The attack caused 300 personnel to be injured with 75 of those being critical. The critical injuries required immediate transfer to a higher level of care. The call went out to the State Department for Aeromedical Evacuation (AE) of the injured personnel. Included in the AE mission was the need for Critical Care Air Transport (CCAT) teams.

In addition to the 300 injured, 15 hostages were captured by the SPRA. Due to limited host nation medical and military capabilities, this situation required more planning on the part of U.S. forces. The U.S. has some Special Forces capability in the area. Those personnel were directed to secure the embassy and the closest airfield in order for AE to commence. The nearest viable airfield is the Shanibian International Airport located 15 miles (approximately 25 minutes) from the embassy.

CCAT INVOLVEMENT

A diplomatic request was initiated by the State Department to allow AE and CCAT to perform their mission of transporting the injured. The request was directed through European Command. Following the request, a phone call was placed to United States Forces Europe to initiate the response team for a noncombatant evacuation operation (NEO).

The Air Operations Center designated the AE and CCAT teams. Following the designation, the teams were notified and directed to report to their respective MTFs to draw medications and ensure they had all needed equipment. This process took several hours because personnel were off duty and, in some cases, out of communications range.

The Medical Treatment Facility (MTF) Commander (MTF/CC) determined that the first CCAT members to arrive would be the first team to go out. Lt Col Potter was coming off his last rotation in the MTF, before beginning to out process. He was the first physician to arrive. Maj White was at the gym on his day off when he got the call. He was the first nurse to arrive. TSgt Black arrived shortly after Maj White. With the team assembled, they gathered their gear and equipment.

The CCAT team collected the necessary medications and equipment based on the initial reports they received about the number and type of injuries. Then the team was bused to the airfield and began to load their equipment on to the selected aircraft. In this case, a KC-46 had been designated based on available information about the runway at the Shanibian International Airport.

The AE crew arrived and configured the aircraft to support the mission. Following configuration, they began the flight to Shanibia. During the flight the CCAT team ensured the equipment was setup correctly, ran through possible scenarios they would encounter, rested, got to know each other, and reviewed Situation Reports (SITREPS).

Lt Col Potter realized that he did not know his team very well since he had been there only two months and spent most of that time at the MTF. He felt he needed to know the team's strengths and weaknesses better. He began asking questions to Maj White and TSgt Black. Maj White was very sharp with his responses and seemed extremely perturbed, while TSgt Black seemed nervous. Lt Col Potter understood that nervousness was expected but she seemed hyper-nervous. Things got worse as the SITREPs started trickling in from the pilots. The injuries included burns, blast related amputations, collapsed lungs, and head injuries. Lt Col Potter decided to run through scenarios with his team to get them focused on what they were about to face.

Their discussions included ways to treat burn and blast injuries, barriers they may face (language, nationality, security, etc.), and support available (liaison teams, non-government organizations, international aid). Maj White knew what to do in every situation. His years of experience were very apparent to Lt Col Potter. The only time Lt Col Potter got concerned was when they would run through scenarios involving young women who had blast related amputations. Maj White's sharpness and irritability surrounding these scenarios led Lt Col Potter to inquire about his team's experience. He learned that Maj White had experienced multiple missions involving young women hit by IEDs in Afghanistan. He also learned that TSgt Black had limited hands-on patient care. She assured him that she could do the job, but admitted she was extremely nervous. In spite of her nerves she could explain what would occur in each scenario and did not miss a single nuance related to the scenarios. She also mentioned she spoke French.

The Concept of Operations concerning attacks on U.S. embassies called for the evacuation of U.S. embassy personnel and citizens first. This required coordination with ground liaison teams and ground medics to determine which critical patients were U.S. embassy personnel or citizens. The patients were both military and civilian.

Due to the number of critical patients, the international community was asked to support the evacuation effort. This required coordination between the teams and the commanding organizations as well as the forces on the ground. The situation on the ground was not completely under control and the CCAT team had to be flexible in order to accept patients not originally on the manifest.

Due to the location of the embassy attack, the first international team to arrive was from France. TSgt Black quickly took over translation and communication with the French team. Together, TSgt Black and her French counterpart were able to determine the extent of each patient's injuries, as well as who and where they would be transported. The team had to adjust their aircraft configuration to accommodate patients whose status changed while the team was in flight. One of the original patients expired while the team was enroute. Also an Embassy worker was found buried in the rubble and was moved to the top of the priority list due to the crush injuries she sustained. The AE crew loaded 20 patients into the aircraft. The CCAT team loaded its four high-acuity patients and the aircraft departed for Germany. However, the aircraft was unable to refuel prior to leaving the Shanibian International Airport; the KC-46 would have to be refueled in flight.

While in flight the CCAT team worked to stabilize their patients. The first patient was an elderly man who worked directly for the Ambassador. He had burns on his left side from his face to his waist. He was having trouble breathing and was intubated prior to flight. The second patient was a female intern who appeared to be only 20 years old. She had shrapnel in her torso and her left foot had been amputated just above the ankle. The third

injured person was a Special Forces Soldier. He had been shot in the chest trying to prevent the hostages from being taken. He replaced the victim who died while they were enroute. The fourth was the Embassy worker who had been discovered buried in the rubble. Her injuries required her to be evacuated immediately. She was an add-on patient. The last two patients were not on the original manifest.

Lt Col Potter sensed that Maj White was having issues dealing with the female so he instructed him to focus on the elderly man and the Soldier. The female amputee was more stable than the others. TSgt Black performed well and handled the patients as if she had been working with them her entire career. Eventually, they were able to get each patient stabilized to the point where the patients only required monitoring. During the flight one of the AE patients became extremely disoriented and the crew feared the patient would hurt himself or those around him. Because the situation had gotten dangerous the AE Medical Crew Director (MCD) asked Lt Col Potter for a solution. He recommended administering a sedative in order to keep everyone on board safe.

Once the aircraft arrived at the airfield, the four critical patients were off-loaded first. The CCAT team transported their patients to the MTF where they conducted a handoff with the MTF critical care providers. During patient handoff, the CCAT team recovered its equipment from the patients. This required the CCAT equipment to be removed from the patients (if feasible) and the MTF's equipment to be put in place. All medical reporting was accomplished post mission. All details concerning in-flight care (including medication and equipment used, patient status, and other pertinent details) were captured in the electronic health record system. The team had to reconcile the information gathered in-flight by the equipment with their notes, and then transfer the information to the receiving facility. The CCAT equipment recovered from the patients was sanitized and an inventory was completed to determine what equipment was needed before the team would be ready for another mission.

An hour later, the CCAT team was told to reload its equipment and prepare for another transfer of injured patients from the Shanibian embassy attack. At this point, Lt Col Potter was beginning to feel the 12 hour shift he pulled prior to the mission, the 24 hours of the mission, and the one hour of post mission clean-up and documentation. He knew that there were patients who needed his team so he decided he would rest while in flight. The previous mission had given him confidence in his team. He knew their strengths and weaknesses and was confident they could handle the next mission just as well.

The second CCAT team to be mobilized was inbound to Germany with three more high-acuity patients from Shanibia and would land within a few hours.

Disruptive Scenario

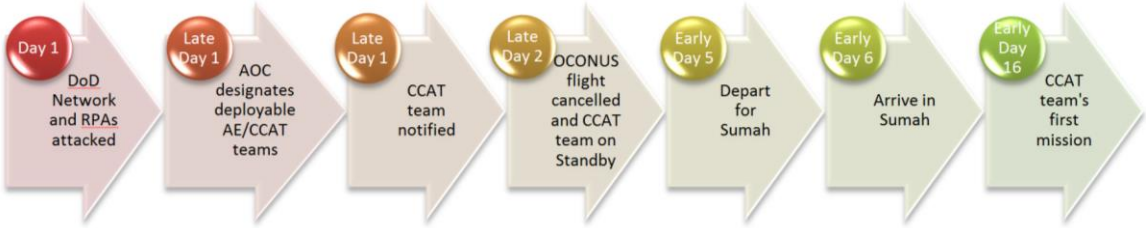
Issues:

Fatigue, Burnout, Tracking of Personnel

ASSUMPTIONS

- The United States has been in a time of peace since 2014. Although there are several OCONUS U.S. military installations, there is currently no permanent forward presence in Torac, Sumuh, or Naem.
- Cyber-attack has only affected Department of Defense networks. Civilian and commercial networks are still operating normally.
- Technological advances in aircraft, navigation and communication systems, and cyber security have been minimal. 2013 technology is similar to what is seen in 2017.
- Due to fiscal constraints, USAF is trying to save money by placing as many AE and CCAT crews on the outbound flight to Sumuh
- This scenario only focuses on the experience of one of the CCAT teams
- CCAT team will pick up equipment and supplies INCONUS

TIMELINE OF EVENTS



CCAT SITUATION

In 2017, the composition of the Critical Care Air Transport (CCAT) team has remained unchanged, but there are no longer any forward deployed Aeromedical Evacuation (AE) crews or CCAT teams due to a period of protracted peace. Therefore, during contingency operations, AE and CCAT crews will be formed stateside and transferred to the area of operation (AO). These designated crews are located all over the United States.

One of the designated CCAT teams is located in Ohio. This team consists of one critical care physician, one critical care nurse, and one respiratory therapist. CCAT personnel backgrounds (*for this scenario*):

Maj Courtney Lane - Critical Care Physician –Maj Lane has been a physician for 9 years. She is an experienced and highly decorated CCAT physician and has gone on numerous deployments. Despite her success, she has lost her motivation to continue in this billet. Although she loves the mission, she is frustrated with what she perceives to be poor management of the CCAT community. She has come to feel that CCAT personnel are "used and abused," and she is burned out from being overworked. Also, her desire to start a family is contributing to her lack of motivation.

1st LT Duane Garrett – Critical Care Nurse – 1st Lt Duane Garrett has recently completed C-STARS and reported to the Ohio Medical Treatment Facility (MTF) last week. He has 2 years of critical care nursing experience in hospitals, but has never deployed.

TSgt Cheryl Fisher – Respiratory Therapist – TSgt Fisher has been in the military for 16 years. The first part of her career was CCAT, but she took a break from the operational side to become a CCAT Instructor at the Basic School. Although she loves to teach, she decided to do one last operational tour before she retires. She is getting older and she is not as strong as she used to be; however, she has great leadership and communication skills.

GENERAL SITUATION

In 2017, the U.S. remains a super power and continues to shape the global security environment. The national security priorities include deterrence of the proliferation of weapons of mass destruction, advance the U.S. cyberspace and cyber security capabilities, and build international partnership and allies.

Sumuh, an ally to the U.S., has just been invaded by Torac. Initial reports believe that several thousand Sumuhians have been killed or critically wounded by Torac's ground and air attacks. The attacks are continuing and Sumuh has asked the U.S. for help. The Sumuh government fears that Torac may not stop unless they retaliate with nuclear force. If the Sumuhians do this, World War III is likely to begin. Fearing this escalation, the U.S. begins to plan and coordinate military action to include medical assistance for the Sumuhians.

INITIAL SITUATION

One hour after Torac's attack Sumuh, the Department of Defense network crashes. Initial reports believe a worm has infiltrated the firewalls and the "blue screen of death" is being displayed on DoD computers throughout the entire U.S. Additionally, it appears that several satellites have also been attacked, causing DoD cellphones, ground positioning system (GPS), and SATCOM radios to be inoperable.

Meanwhile at the Hideo Air Force Base, several remotely piloted aircraft (RPAs) are not responding to ground control station (GCS) inputs. The operators are claiming that the RPAs are flying themselves and it appears that someone else is overriding the control. Two fly away, but one seems to be deliberately flown into the ground in the nearby city. This incident has left the public doubting the military's RPA capabilities. Until further notice, all RPAs are grounded.

The cyber security, intelligence, and information dominance communities are working to determine who or what is responsible for these technological problems. Initial reports believe that the hostile nation of Naem is behind these attacks and it is possible that they are working with Torac directly.

CCATT INVOLVEMENT

The Air Operations Center (AOC) usually begins the official designation of AE and CCAT teams who will be deploying; however, the tracking data cannot be accessed since the network is down. There is one paper copy located in the office, but this matrix has not been updated since 2014. Therefore, current qualifications and certifications, training, deployment cycles, C-STARS course grades, current locations, and recall numbers are not available. This causes significant problems because without this information the AOC does not know where its people are and whether they have the currency requirements to deploy. Usually AE and CCAT personnel are deployable within 72 hours, but the computer problems are delaying the recall process.

Using a non-DoD landline, the AOC begins to call personal cell phones. Additionally, calls are being made to base hospitals to see if they have any CCAT personnel available to deploy. This process takes several hours.

Fortunately, TSgt Fisher, an RT with all the necessary qualifications, has had the same telephone number since 2010 and picks up right away. The AOC notifies her that her team has been recalled and is set to deploy tomorrow at 0800 local. TSgt Fisher immediately pages Maj Lane and 1st Lt Garrett over the hospital's 1MC. Both Maj Lane and 1st Lt Garrett are at work and rush over to TSgt Fisher's office. (If they had not been

at the hospital, TSgt Fisher may not have been able to find the nurse since he is a new check-in.)

This CCAT team has never worked together; however, they have all seen each other around the hospital. As the natural leader of the group, TSgt Fisher takes charge and passes on what little information she knows. Before the team goes their separate ways, they sit down and formulate a plan, a list of supplies, and all the things that need to get done before they depart. This takes them about an hour, but each person leaves knowing exactly what he or she needs to do in the time remaining. Also, the members exchange their personal cell phone numbers since their DoD cell phones and email are inoperable.

At approximately 1500, TSgt Fisher receives another call from the AOC informing her to be at the airport for a 0500 takeoff. She relays this information to her team. Rushing to get everything done, Major Lane is visibly upset. She did not expect to have to deploy on such short notice. Years ago, this would have not fazed her. To make matters worse, Major Lane's husband is angry that she is deploying. He knows the toll these deployments take on his wife and is concerned for her physical safety as well as her mental well-being. 1st Lt Garrett is excited, but overwhelmed since most of his deployment gear is still in boxes. He has only been in his apartment for a week and has not had a chance to unpack.

The following day, the team meets at the airfield. Maj Lane's husband and TSgt Fisher's family are there to say goodbye. The flight does not arrive at 0500. No one at the airport knows why the flight is delayed and TSgt Fisher is unable to contact anyone at the AOC. The weather outside is beautiful and line of sight radios are working fine in the aircraft so there is no flight safety issue. The team decides to wait it out in the terminal. Maj Lane's frustrations increase. TSgt Fisher understands this is the nature of deployment and 1st Lt Garrett doesn't know any better.

After several hours of sitting in the terminal, TSgt Fisher finally is able to contact the AOC. The AOC notifies the CCAT team that the network is still down and they are unable to get the orders generated. Paper copies are being drafted and should be authorized by tomorrow morning. The team is told to "standby," and to be ready to deploy within 30 minutes of the call. The CCAT team and their families return home for the night.

A few days go by without much contact from the AOC. TSgt Fisher keeps questioning whether she may have missed a call and won't let her cell phone out of her sight. She decides to call up everyone she knows to see if she can find out what is going on. After about 10 calls, one of her old AE pals informs her that the reason for the delay was because the AOC was trying to assemble the other AE/CCAT teams so they could all

take the same flight. This proved difficult without computer access and an accurate recall roster.

This wait is challenging because the team doesn't want to go to work at the hospital in case they are recalled. They cannot plan any activities with their families or go anywhere because they must be able to report to the airfield within 30 minutes. This uncertainty and waiting is not only stressing the CCAT team, it is also causing distress within the families.

Finally, after four days of being on 30 minute recall, AOC notifies TSgt Fisher at 0330 that their orders have been authorized and takeoff time is at 0500. At 0500, five AE crews and three CCAT teams load their gear and board the plane to begin their OCONUS flight. After three fuel stops and after 24 hours of travelling, the team finally arrives at the MTF in Sumuh.

The CCAT team quickly learns that the cyber-attacks also have caused issues here in Sumuh. Cyber personnel have set up a functioning internal network; however, communications to CONUS are only possible via Sumuh landlines. Personal cell phones are only being used in emergency situations due to security and high international fees. Loss of GPS and SATCOM is causing major delays for aircraft.

Sumuh is a mountainous country with dense foliage. GPS and SATCOM in this type of environment are critical to flight safety and mission accomplishment for several reasons. First, the few airports that exist in Sumuh have limited equipment; navigational aids (TACAN, VOR) and continuous radar tracking are minimal. Without GPS, aircraft are having a difficult time finding airports and check points. Pilots have had to revert to using aeronautical maps for navigation. Unfortunately, there are a limited number of maps and most are out of date. Although it is against regulations to fly without up to date maps, the crews are doing it. Second, the language barrier is making it difficult for pilots to communicate their intentions and receive advisory calls. Third, the AF installation at Sumuh does have several ground and inflight ultra-high frequency (UHF) and very high frequency (VHF) radio frequencies, but these are line of sight (LOS). Communication is lost once aircraft are 20 miles away because the airfield is surrounded by mountains. There are several UHF and VHF frequencies for position reports and advisory calls; however, only the military are consistently monitoring these frequencies. Usually, the aircraft use SATCOM because it eliminates the LOS issues and allows the aircraft to maintain contact with the area of responsibility's (AOR's) air traffic control, ground personnel, and nearby aircraft. Relying only on the LOS radios is a dangerous in a new AOR, especially when there are no established course rules in and out of the airports. Lastly, the RPAs normally provide Intelligence Surveillance and Reconnaissance (ISR) for the aircraft and personnel on the ground; however, they are still grounded for fear that

the Naemians will take them over and use them against friendlies. In a new operating environment, with minimal radio cover, and out of date publications, aircraft are only launching during the daytime using visual flight rules (VFR). These technological problems, elimination of night operations, and bad weather are causing major delays to the flight schedule.

The CCAT team quickly realizes that they will be playing the "hurry up and wait" game here as well. Due to the unpredictability of aircraft availability and scheduling, the AE/CCAT teams are placed on a 15 minute alert status. Many of the teams are not happy with the way things are being run at the MTF, and frustration is high. Maj Lane is near her breaking point. Without email, she is unable to talk to her husband to let him know she arrived safely. She wants to quit but she knows she cannot let down her team. With all the waiting around, 1st Lt Garrett cannot figure out why he is so tired. He hasn't done anything, yet he can barely stay awake.

TSgt Fisher has been on many deployments and understands this is the nature of the business. She assumes that once things settle down, AE/CCAT missions will start launching regularly and they can get on a schedule. She sees the distress in her team and decides that they should make use of this down time to re-inventory their equipment and discuss some scenarios they may encounter.

A week goes by, and no AE/CCAT teams have launched. To keep her team busy and their minds in the game, TSgt Fisher decides to put on her "instructor" hat and provide the team with some training on specific topics regarding crew resource management and contingency response.

Finally, after ten days, the CCAT team gets its first mission. Although Maj Lane is burnt out, she has grown fond of her two teammates and they have given her motivation to continue. She is glad that the team has made the most of this down time and it is apparent that it helped. Communication between the three is spot on and even though this is their first mission together, they all trust each other to do their jobs. Despite her negative views, Maj Lane realizes this is the best team on which she has ever worked.

GPS and SATCOM are still down. The pilots are having a difficult time finding the landing strip and the ground personnel are trying to give those vectors. This navigational issue jams up the communications with the ground and the AE/CCAT teams do not know what to expect down below. As soon as they land, there are four high acuity patients and two low acuity patients. Common practice is to only take three high acuity patients, but due to the delay in CCAT missions, there is an overflow of critically wounded and injured patients. The team knows they should follow regulations so TSgt Fisher holds a quick team discussion. All agree to take the additional patient.

As the aircraft launches on the five hour transit to the Level 5 hospital, Maj Lane begins to question whether her team will have enough supplies to make it through the next week. She discusses her concerns with her team. As soon as they get back, they will need to request more supplies. TSgt Fisher does a few quick calculations. Within a week, they will need those supplies. Hopefully, a week of notice is enough time for the supply department to locate the supplies and have them available.

During the transit, the team is able to successfully handle four patients, but they had no time to rest because two of the patients had complications. Despite these issues, the team is working well together. Maj Lane would never agree to more high acuity patients if her team wasn't working so well together.

Upon landing, the CCAT team transfers the patients over to the ground personnel. The aircrew notifies the CCAT team that they will be going back for another pickup. The team members conduct a debriefing, clean up the equipment, and get a quick nap. Thankfully, the team has enough snacks and water to keep them going for several more hours.

This deployment turns out to be unlike any other. The team pulls several long shifts on days when the weather is good and they are incredibly bored on days when the weather is bad. This vacillating and unpredictable operational tempo (OPTEMPO) last for several weeks. The team never gets used to the extremes of high OPTEMPO and virtually no OPTEMPO. Maj Lane is counting down the days until she can resign from CCAT. She believes the management of this mission could have been done much better.

Catastrophic Scenario

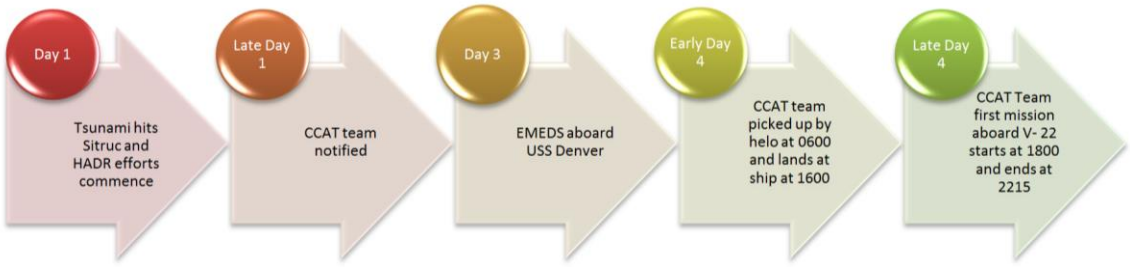
Issues:

Adrenaline Junkie, Resilience, Team Formation, Fatigue

ASSUMPTIONS

- Sitruc is an ally of the United States
- EMEDS teams are capable of setting up a LVL II MTF aboard an amphibious assault ship.
- This scenario only focuses on the experience of one of the CCAT teams without the assistance of an AE crew

TIMELINE OF EVENTS



CCATT SITUATION

In 2020, budget cuts and peace-time operations have decreased the number of OCONUS Aeromedical Evacuation (AE) and Critical Care Air Transport (CCAT) teams. Most of these personnel are located within CONUS. One of the OCONUS Medical Treatment Facilities (MTFs) is located on the island nation of Sitruc. That MTF currently has two AE crews and one CCAT team. In the last 6 months, that CCAT team has not been used and USAF decision makers are questioning whether this asset is needed in Sitruc.

Each CCAT team is made up of one critical care physician, one critical care nurse, and one respiratory therapist. CCAT personnel backgrounds (*for this scenario*):

> **Lt Col Wayne Gunter** – Critical Care Doctor – Lt Col Gunter has 15 years of critical care experience. He is a Harvard Medical School graduate and entered the military because he loves a challenge. He volunteered for several back-to-back deployments to Iraq and Afghanistan. Described as arrogant and abrasive, this go-getter loves the thrill of the CCAT mission. Since he is single, he decided to

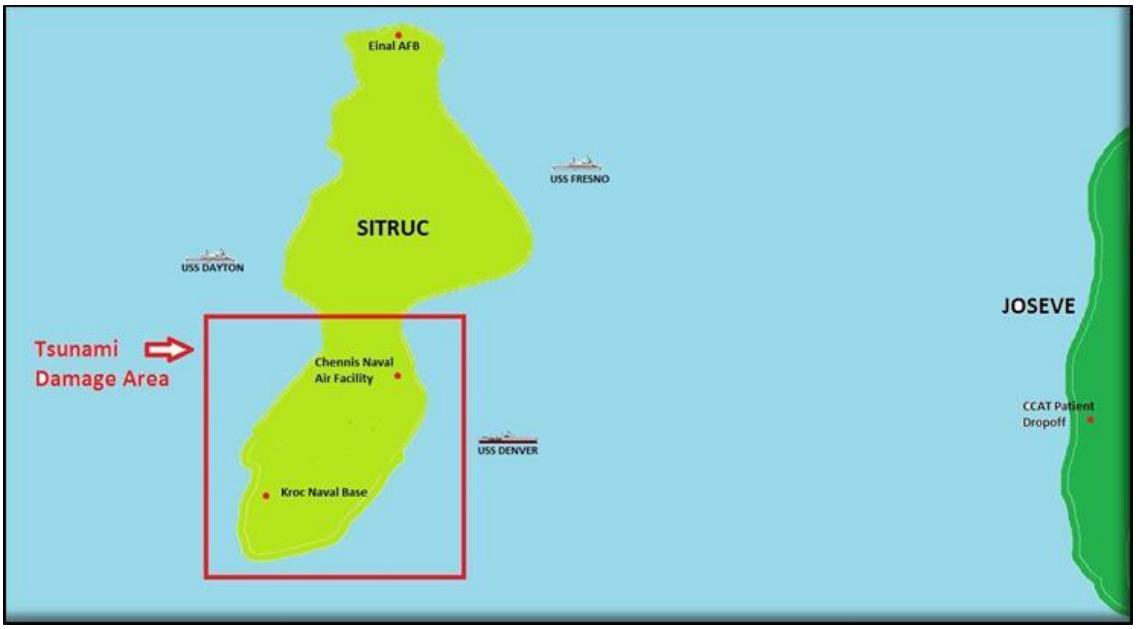
volunteer for an OCONUS CCAT position because he felt that he would see more "action." However, the peacetime operations in Sitruc have led to few CCAT missions and he has grown restless. As his boredom has grown so has his dislike for his present assignment in Sitruc.

Capt Steve Eiki – Critical Care Nurse – Captain Eiki has been a nurse for 7 years. His first deployment was to Afghanistan. Catching the tail end of the war, he gained little experience because operations were drawing down during his tour. He just transferred to Sitruc a few months ago. He did not want to deploy overseas but the needs of the USAF came first. He is a quiet guy and has been criticized in the past for not speaking up. He knows his "stuff" and feels confident, but the way he carries himself makes people doubt him. He is debating on whether he should leave the USAF after he has fulfilled his current service obligation even though he likes the CCAT mission. He is hoping that this tour will renew his motivation to continue his military career.

TSgt Barbara Rucend – Respiratory Therapist – TSgt Rucend was recently promoted and has been in the AF for 8 years. She volunteered for an OCONUS assignment and is about to transfer in 2 weeks. She has never deployed as CCAT and took the job to help boost her career. She is known to be somewhat "accident-prone," especially when her excitement gets the best of her. Many of her superiors have counseled to slow down and concentrate more on her assigned tasks.

GENERAL SITUATION

In 2020, the U.S. is an active member of various international coalitions and continues to develop diplomatic relations with many countries. The country of Sitruc remains a close partner with the U.S. Due to its strategic location, there is a strong U.S. military presence in Sitruc. There are three U.S. military bases located in Sitruc: Einal AFB is located in northern Sitruc; Chennis Naval Air Facility is located in central Sitruc; and Kroc Naval Base is located in southern Sitruc. Currently, there are twenty U.S. warships either home-ported in Sitruc or forward deployed in the surrounding region. Additionally, there is one USAF flight wing and two Navy helicopter squadrons located on the island. Approximately 40,000 U.S. military personnel and their families live in Sitruc.



INITIAL SITUATION

A 9.1 magnitude earthquake has created a tsunami off the coast of Sitruc and an 80 foot tidal wave has hit the southern portion of the island. Initial reports indicate several thousand Sitrucians and Americans are dead or injured. This catastrophic event causes great damage to the area, including the two Naval Bases. At the time of the tsunami, most of the ships were forward deployed or conducting exercises outside of the local waters. Two ships pier side at Kroc Naval Base suffered minor damage. Both Navy Helicopter Squadrons were at sea when the tsunami hit the island. Therefore, the damage to the base was confined to the equipment left behind and the infrastructure. Although the epicenter was in the ocean 100 miles southwest of Sitruc, the aftershocks have been felt all the way to the North and are causing significant ground movement throughout the country.

News of this tragedy spread quickly and within several minutes the Unified Combatant Command Headquarters was notified. The U.S. begins to coordinate Humanitarian Aid/Disaster Relief (HADR) support with several relief agencies and several allied countries.

One of the assets in the area is the U.S. Navy's Denver Amphibious Ready Group (ARG). This group of ships was conducting exercises for their upcoming deployment. The ARG is comprised of three ships: USS DENVER (LHA 14); USS FRESNO (LPD 24); and USS DAYTON (LSD 4). Aboard these three ships are the 44th Marine Expeditionary Unit (MEU) and approximately 22 Navy and Marine Corps aircraft.

Specifically, there are two Harriers (AV-8), fifteen Helicopters (five CH-53; three AH-1; four UH-1; three MH-60S) and five Ospreys (V-22). Currently, the ARG is 150 NM due east of Sitruc and should be in the vicinity of Sitruc within 5 hours to aid in relief efforts. Due to the unpredictable sea state and potential whirlpools, the closest the ARG can get is 30 NM east of the Island.

A Joint Air Operations Center (JAOC) has been established to direct all aviation support. Diplomatic requests from the State Department have been initiated and once within range, the two Harriers, Dragonwhale 114 and Dragonwhale 222, take off from the deck of USS DENVER to survey and assess the destruction. The Dragonwhales are the first on scene and communicate over SATCOM with the USS DENVER. Once "feet dry," Dragonwhale 114 breaks towards the North, while Dragonwhale 222 continues South. Each report the same thing: there is significant damage to both civilian and military airport runways. All runways and airports in the South are destroyed. The northern runways and airports are cracked due to the strong aftershocks.

The command center has received several situation reports (SITREPs) about local airports. The longest serviceable runway so far is only 1000 feet and is located at the northernmost tip of the island. This caused great concern at the command center since most of the airpower at Einal AFB is large fixed wing aircraft (e.g., C-130, C-17, and C-5). These aircraft are unable to land on such a short runway and cannot launch until the base's runway has been repaired. Since the USAF fixed wing aircraft are temporarily grounded at Einal, the only air assets available are USAF helicopters and the Denver ARG aircraft. The command center orders several helicopters to launch off the USS DENVER and to begin identifying landing zones in the vicinity of South Sitruc.

CCAT INVOLVEMENT

Since this is a mass-casualty situation, the National Defense Medical Service, Public Health personnel, and local disaster teams initiate the disaster response protocol. Alerts were sent to all first-responder medical teams on the island and it was determined that the USAF Expeditionary Medical Support (EMEDS) team located at Einal AFB was closest to the damaged area. While the EMEDS teams assemble and prepare for the HADR mission aboard the USS DENVER, the Critical Care Air Transport (CCAT) Teams are called up by the Air Operations Center. Although more CCAT personnel have been notified, Lt Col Gunter, Capt Eiki, and TSgt Rucend will be the only crew for several days. AE personnel are stationed at Einal AFB; however, they will not be accompanying the CCAT team on the first few missions due to the small cabin space aboard the helicopters.

Due to the limited range of the helicopters, several legs must be flown from Einal to the damaged areas on the southern part of the island. Medical personnel will have to fly to "leapfrog" from one landing zone (LZ) to the next and possibly change aircraft multiple times before they can make it to the damaged area. The USS DENVER is anchored 30 NM due east of the damaged area; whereas USS FRESNO and USS DAYTON have been anchored strategically along the operating area as refueling platforms.

It is now four days after the earthquake and tsunami. Since the USAF MTF is so far away and nearby hospitals are destroyed, the nearest Level II hospital is aboard the USS DENVER. Food, water, and sanitation facilities have been set up at the point of injury by the disaster relief teams and Public Health Personnel. Until the runways can be fixed, Navy MEDEVACs are being flown from the point of injury to the USS DENVER.

Two EMEDS teams have been aboard the USS DENVER for 48 hours and have started to provide triage. EMEDS is now ready for critical patients to be transferred off the ship. When runways become available, the traditional AE/CCAT missions will be conducted. Since that support is still a few days out, the CCAT teams will transfer the critically injured patients from the ship using V-22s to the nearest Level V hospital. This hospital is on the mainland of Josevo and its nearest airport is approximately 300NM from the ship.

The three CCAT members are notified of their mission and are given a take-off time of 0600. Unfortunately, the CCAT team has never been aboard a ship, never operated in a tilt rotor aircraft, and will not have an AE to set up the equipment. The CCAT team will have to rely on the Marines to help set up the cabin area and battery power since the V-22s have different electric plugs. With no up-to-date doctrine or policy on this type of contingency operation, the team will have to remain flexible and adapt as necessary.

Lt Col Gunter gathers his team and orders them to get their gear packed. This CCAT team has never worked together during an actual mission. Lt Col Gunter is quick to judge the abilities of his nurse and RT. He distrusts his team without even knowing whether his assumptions are true. He is frustrated that CCAT personnel are no longer the "best and brightest," and begins to take his frustrations out on Capt Eiki and TSgt Rucend. Lt Col Gunter's treatment of his team members causes a breakdown in communication. During their preparation, Capt Eiki and TSgt Rucend are hesitant to interact with Lt Col Gunter.

Lt Col Gunter is unsure what will fit on the aircraft, so he tries to downsize and prioritize what equipment and medication he will need. He packs "go-bags" according to what he expects to see. TSgt Rucend appears frantic and disorganized. Capt Eiki writes down a list of tasks for her to follow which helps to get her focused. Capt Eiki has had this list

with him since his first deployment and he has always used to check himself and ensure he has everything.

With their gear packed, the team boards a USAF helicopter. After a two hour flight, the aircraft drops them off at the first LZ. The team must unload all the gear from the first aircraft and wait in a field for the second aircraft. While they wait, Lt Col Gunter keeps to himself as he goes over possible scenarios in his head but does not use this opportunity to share his thoughts with his team. After roughly an hour, the CCAT team is picked up by a MH-60 and flown to USS DENVER. They land at approximately 1600. It has already been a long and exhausting day, but there are roughly 12 critical care patients that need to get off the ship immediately.

The Air Operations aboard the USS DENVER assume this can be done in one hop since the V-22 has space for 12 litters. Unfortunately, the Air Department overlooks the fact that the CCAT crew has a lot of equipment and will not be able to take them all at once. To add to the confusion, the Marine aircrew is unfamiliar with the medical equipment and the Aircraft Commander refuses to takeoff if the equipment has to be hooked to the airframe. Luckily, the batteries are fully charged and will be able to last for at least 8 hours. Lt Col Gunter receives the transfer paperwork from the EMEDS team and begins to bark orders to his team as the litters are being loaded. Capt Eiki's back is a little sore, but ignores the pain and keeps quiet. Once the gear is secured inside the aircraft, only 4 littered patients are able to fit inside at one time. This throws another wrench in the plan since three flights will be required from the USS DENVER to the airport in Josevo.

Finally at 1800, Dragonwhale 614 is given green deck and launches. Immediately the team recognizes differences between the fix wing aircraft and the Osprey. Although the ride is relatively smooth, the ICS portable radios are old and it is hard to hear what is being said. Also, the spacing is a little more cramped than usual, and TSgt Rucend is feeling a little uncomfortable with the close quarters. The four patients onboard are ventilated and remain stable during the 1 hour and 15 minute flight to the mainland.

At Josevo, the four patients are handed off to the ground personnel who are waiting at Base Operations. On the way back to the ship, Capt Eiki and TSgt Rucend clean the equipment and sanitize it, while Lt Col Gunter fills out the mission paperwork. With a heavy tailwind, the Dragonwhale 614 lands at approximately 1830.

At this point, Lt Col Gunter sees that his crew is starting to get tired. TSgt is yawning and Capt Eiki looks drained. Lt Col Gunter doesn't understand why they are acting this way. During the war, he was flying 18 hour days and never complained. His adrenaline is pumping and he is eager to get the next crew onboard. Four more ventilated patients are transferred to the CCAT team and Dragonwhale 614 launches for the second time.

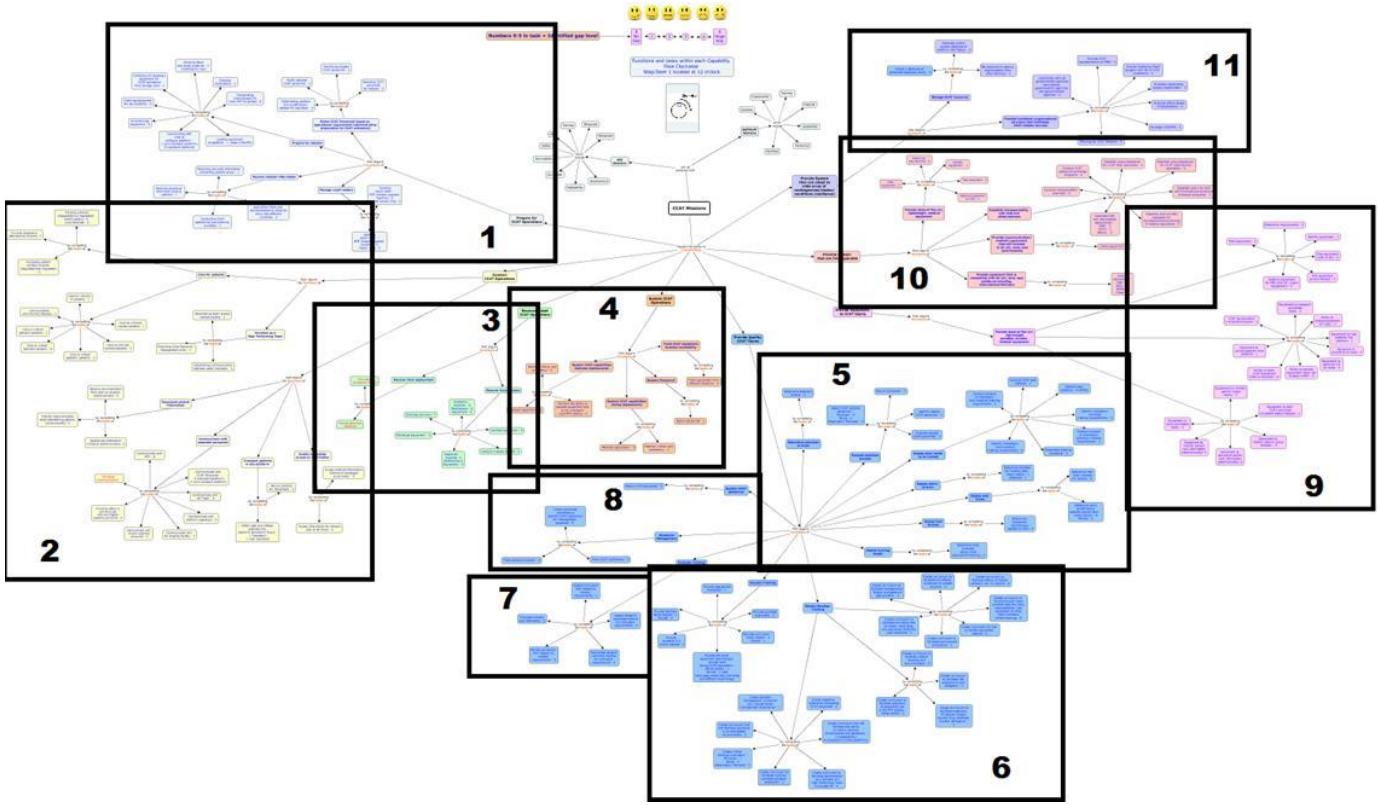
Again, the flight goes relatively smooth. Capt Eiki administers medicine, while TSgt monitors vital signs. They land in Josevo at approximately 2015. This time there is no one to greet them at the airport due to a miscommunication with the ground crew. The CCAT team and aircrew wait for almost an hour before the patients are transferred.

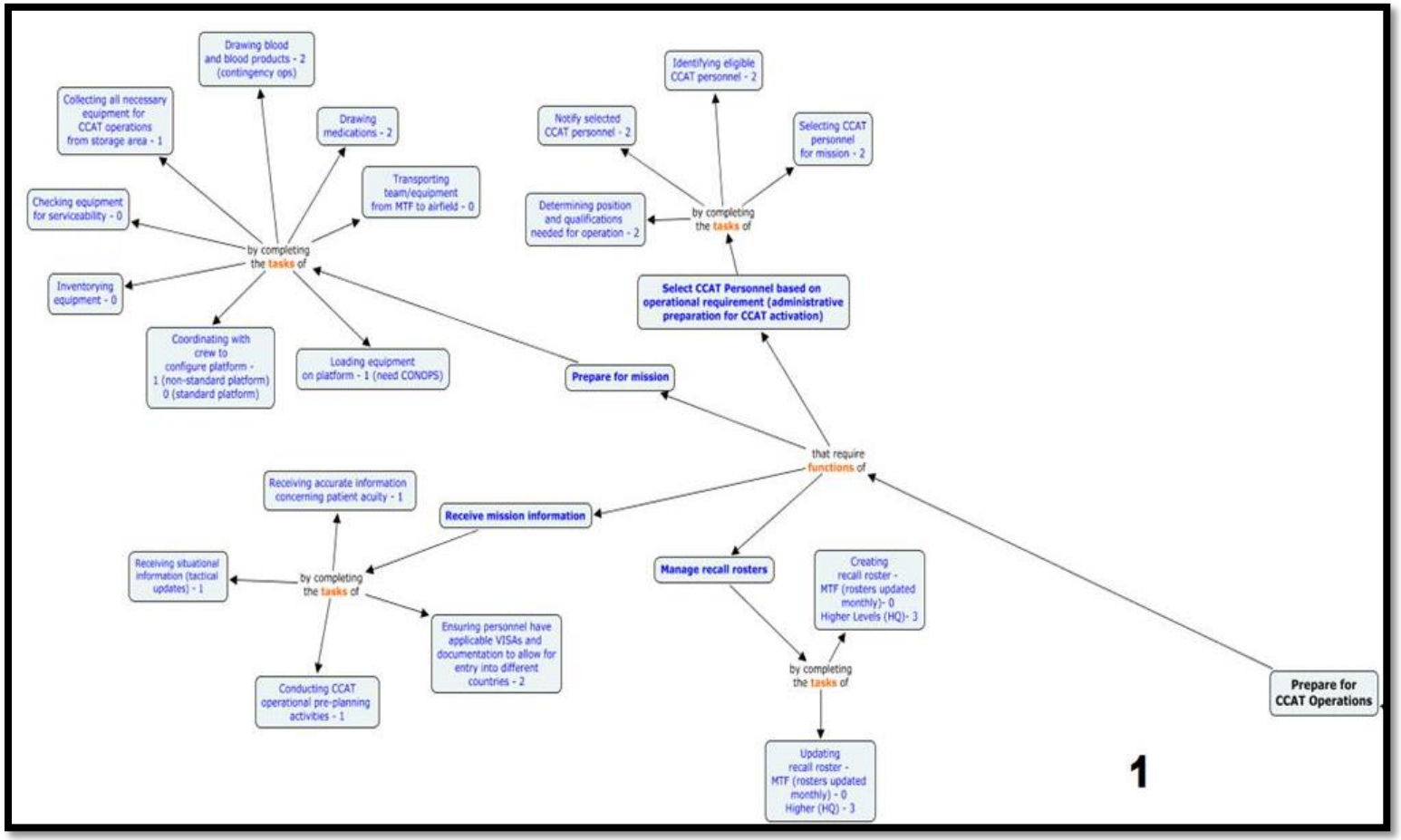
On the way back to the ship, Capt Eiki has reached his breaking point. He is physically and mentally drained. After 16 hours of flying, his back is killing him. He also is hungry, because the team has not had dinner. Capt Eiki decides to voice his concerns to Lt Col Gunter. Capt Eiki suggests they wait until the morning to take the remaining patients since it has been a long day today and there will be another long day tomorrow. He also mentions that their team has not had dinner and the battery is running low. If there is another delay on the ground, the battery may drain before the patients can be hooked to the new equipment at the hospital. In his opinion, this is a risk not worth taking. After Capt Eiki mentions his fatigue, TSgt Rucend nods her head and breathes a sigh of relief. She is relieved that Capt Eiki has confronted Lt Col Gunter. Lt Col Gunter is angry and appalled that his team would complain about their long day when there are thousands of patients that need to be transferred. Lt Col Gunter's adrenaline is so high, he isn't even hungry. He is eager for another flight and views the battery issue as a game he is excited to play. Instead of listening to his team, Lt Col Gunter speaks to them about his CCAT missions during the Iraq war. As Lt Col Gunter continues to counsel his crew for their poor attitudes, Capt Eiki tries to figure out what his next moves will be because he knows that if they launch again, mistakes will happen.

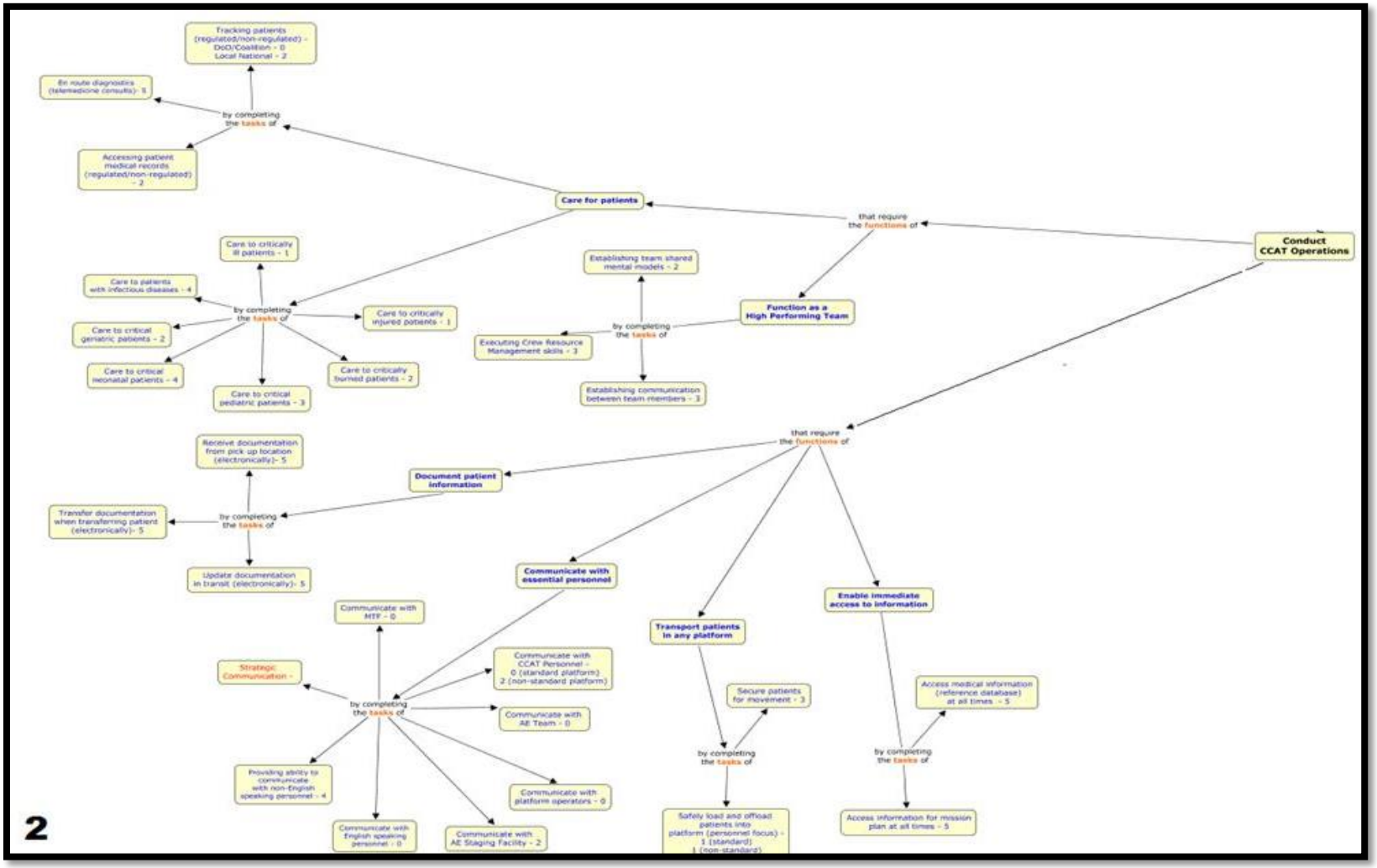
At approximate 2215, Dragonwhale 614 lands on USS DENVER. As the CCAT team departs the aircraft, Capt Eiki hears the engines shutdown and sees the rotor heads start to fold. He is confused and asks the aircrew what is happening. Capt Eiki is delighted to hear that flight quarters have been secured for the night since the flight crew has reached their crew day limitation. The remaining patients will be flown first thing in the morning. Capt Eiki feels sudden relief as he knows that his team has just avoided a very dangerous situation.

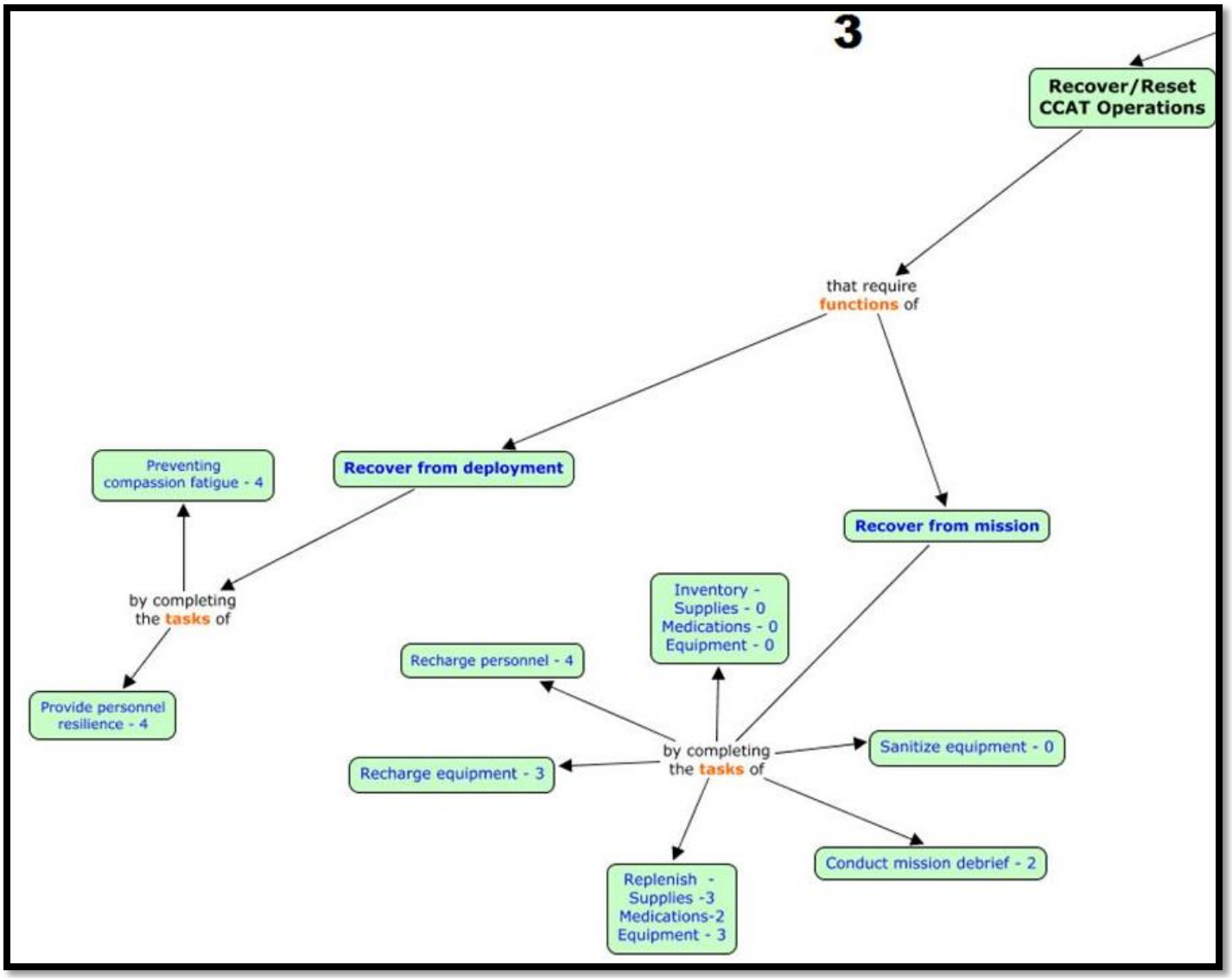
APPENDIX P. FINALIZED CCAT CBA CONCEPT MAP HTA

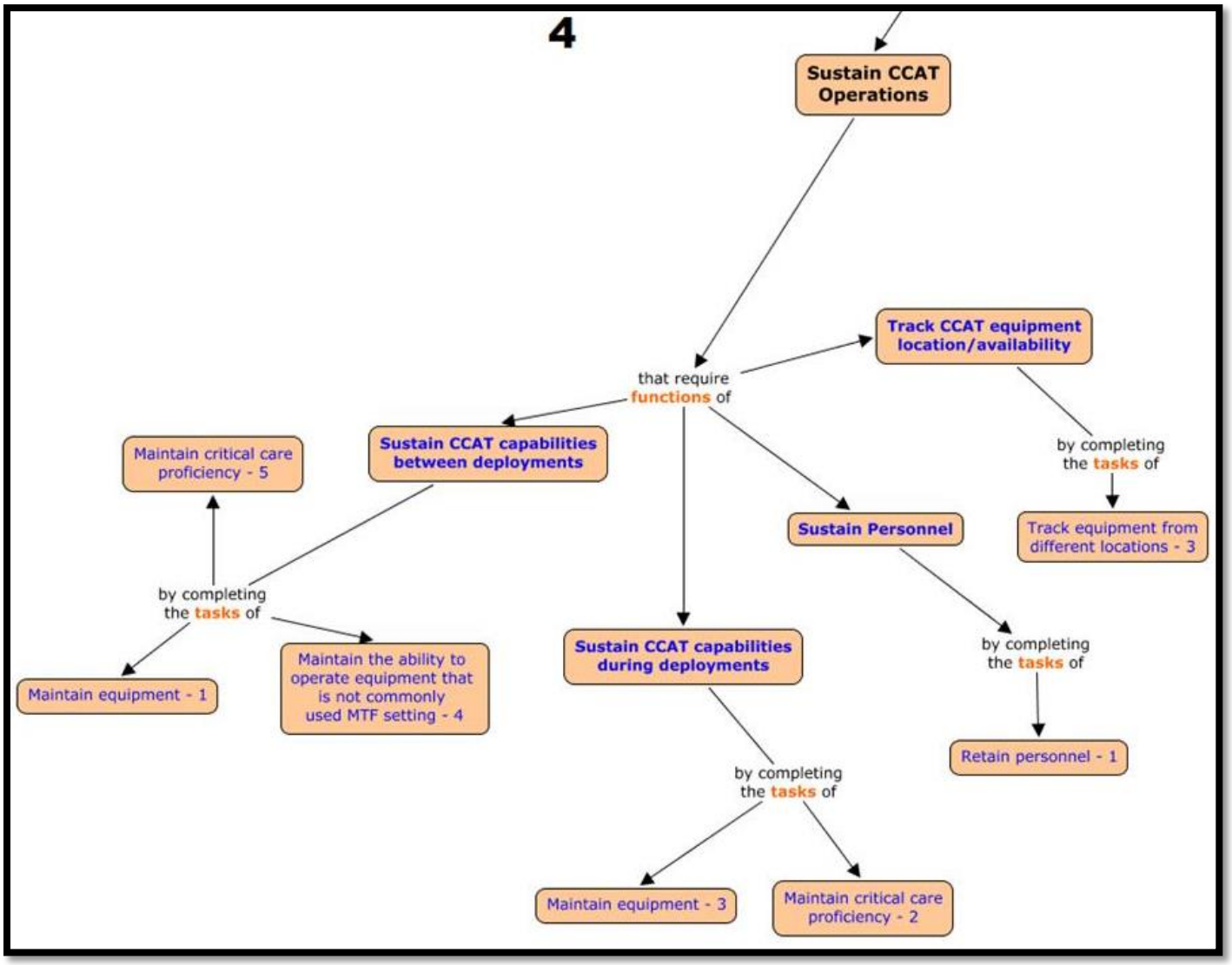
The finalized HTA concept map was created by the CCAT CBA analysis team. This concept map was included in the CCAT CBA final report

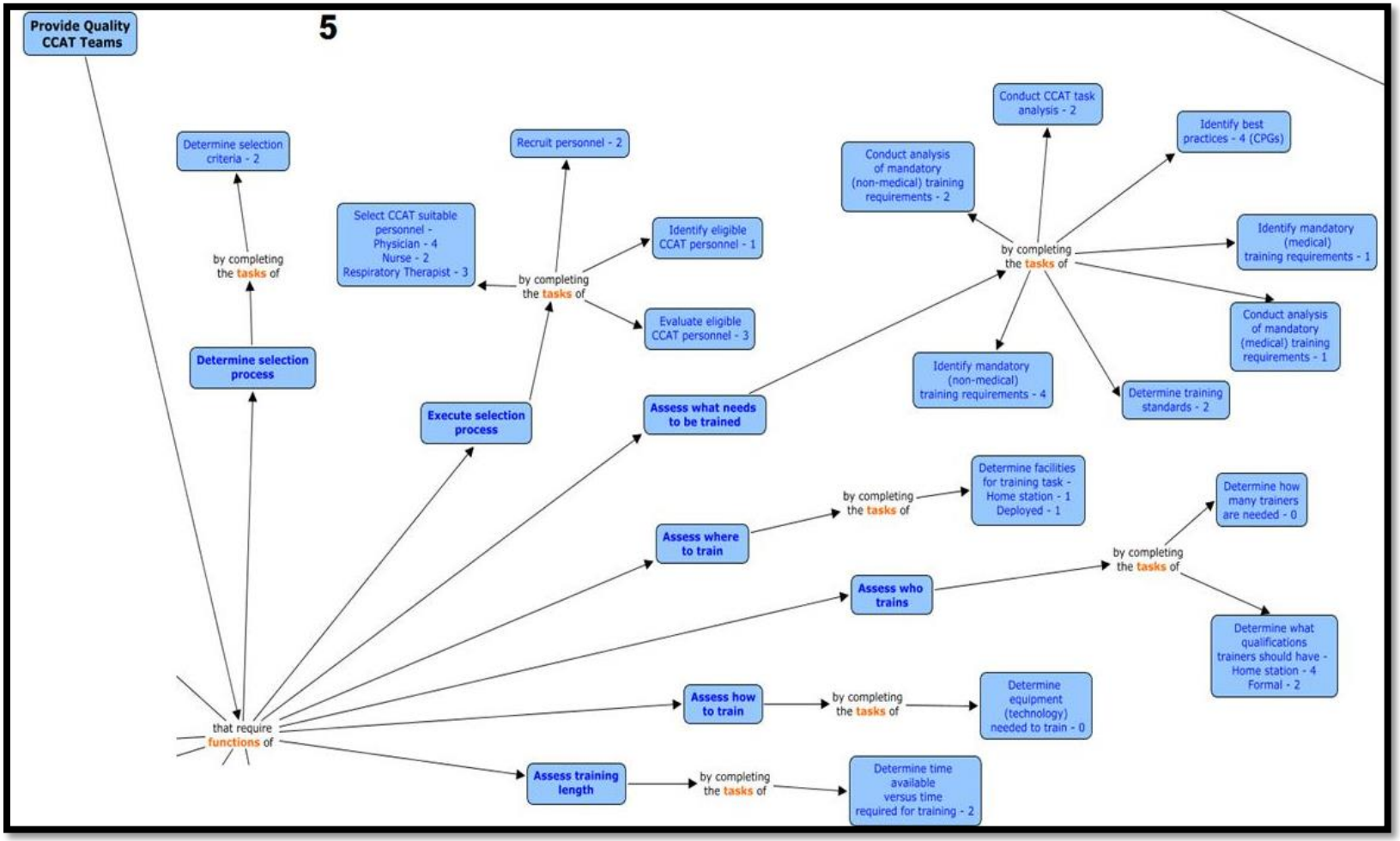


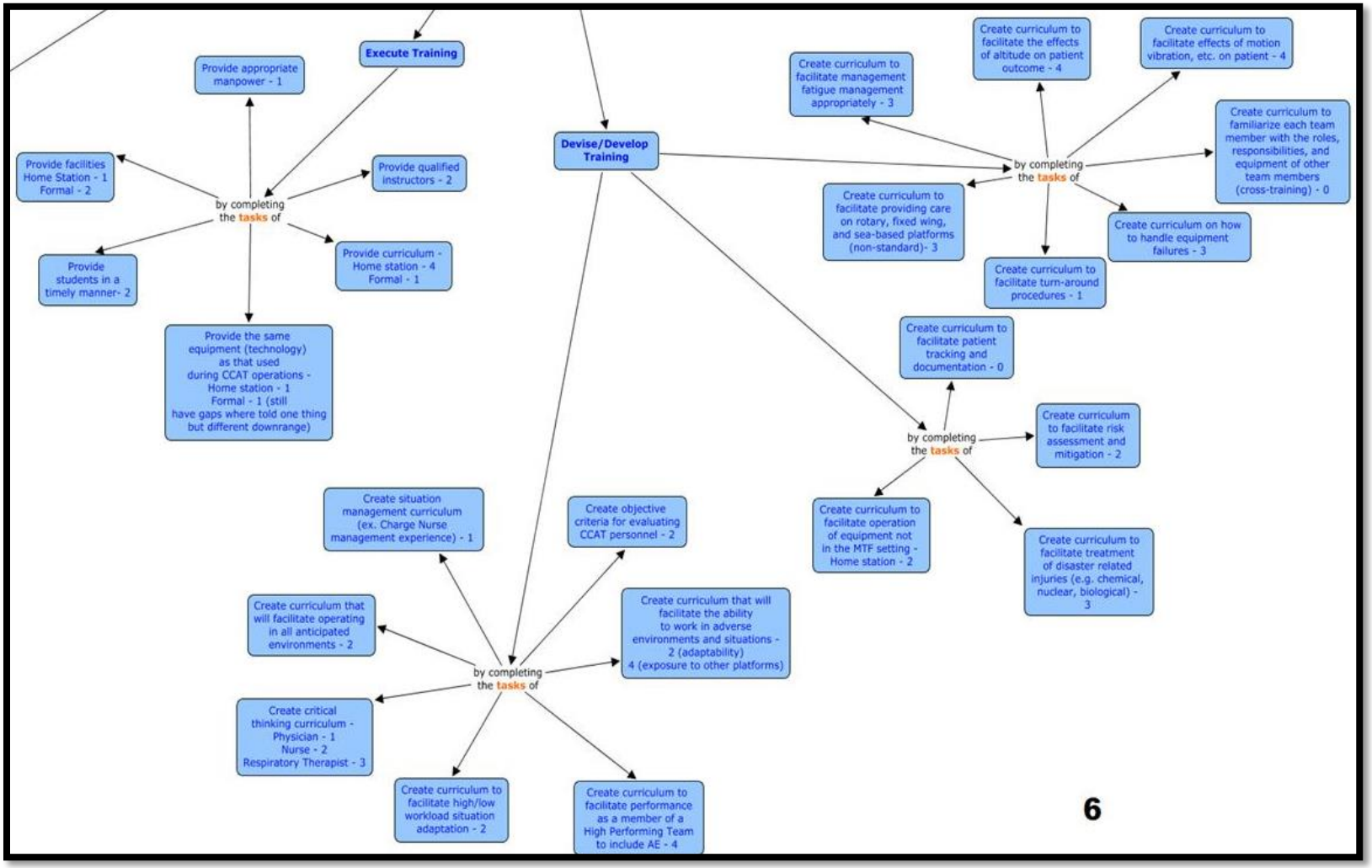

Drawing blood and blood products - 2 (contingency ops)
Collecting all necessary equipment for CCAT operations from storage area - 1
Drawing medications - 2
Transporting team/equipment from MTF to airfield - 0
Checking equipment for serviceability - 0
by completing the tasks of
Inventorying equipment - 0
Coordinating with crew to configure platform - 1 (non-standard platform) 0 (standard platform)
Loading equipment on platform - 1 (need CONOPS)
Prepare for mission
Identifying eligible CCAT personnel - 2
Notify selected CCAT personnel - 2
Selecting CCAT personnel for mission - 2
Determining position and qualifications needed for operation - 2
by completing the tasks of
Select CCAT Personnel based on operational requirement (administrative preparation for CCAT activation)
that require functions of
Receiving accurate information concerning patient acuity - 1
Receive mission information
Receiving situational information (tactical updates) - 1
by completing the tasks of
Ensuring personnel have applicable VISAs and documentation to allow for entry into different countries - 2
Conducting CCAT operational pre-planning activities - 1
Manage recall rosters
Creating recall roster - MTF (rosters updated monthly)- 0 Higher Levels (HQ)- 3
by completing the tasks of
Updating recall roster - MTF (rosters updated monthly) - 0 Higher (HQ) - 3
Prepare for CCAT Operations
1

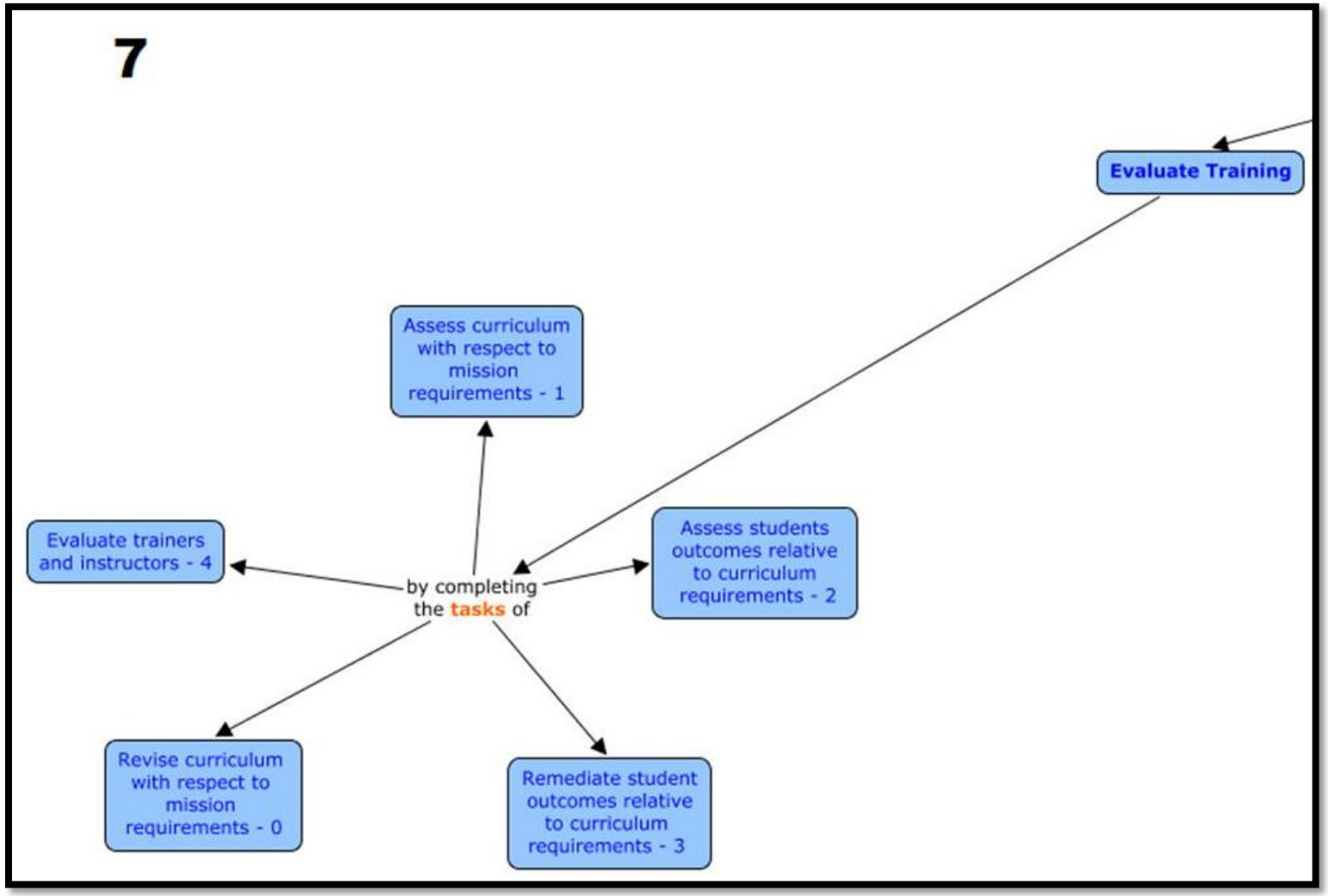

Conduct CCAT Operations
that require the functions of
Care for patients
Function as a High Performing Team
Document patient information
Communicate with essential personnel
Transport patients in any platform
Enable immediate access to information
by completing the tasks of
Tracking patients (regulated/non-regulated) - DoD/Coalition - 0 Local National - 2
En route diagnostics (telemedicine consults)- 5
Accessing patient medical records (regulated/non-regulated) - 2
Care to critically ill patients - 1
Care to patients with infectious diseases - 4
Care to critical geriatric patients - 2
Care to critical neonatal patients - 4
Care to critical pediatric patients - 3
Care to critically injured patients - 1
Care to critically burned patients - 2
Establishing team shared mental models - 2
Executing Crew Resource Management skills - 3
Establishing communication between team members - 3
Receive documentation from pick up location (electronically)- 5
Transfer documentation when transferring patient (electronically)- 5
Update documentation in transit (electronically)- 5
Communicate with MTF - 0
Strategic Communication -
Communicate with CCAT Personnel - 0 (standard platform) 2 (non-standard platform)
Communicate with AE Team - 0
Providing ability to communicate with non-English speaking personnel - 4
Communicate with English speaking personnel - 0
Communicate with platform operators - 0
Communicate with AE Staging Facility - 2
Secure patients for movement - 3
Safely load and offload patients into platform (personnel focus) - 1 (standard) 1 (non-standard)
Access medical information (reference database) at all times - 5
Access information for mission plan at all times - 5
2

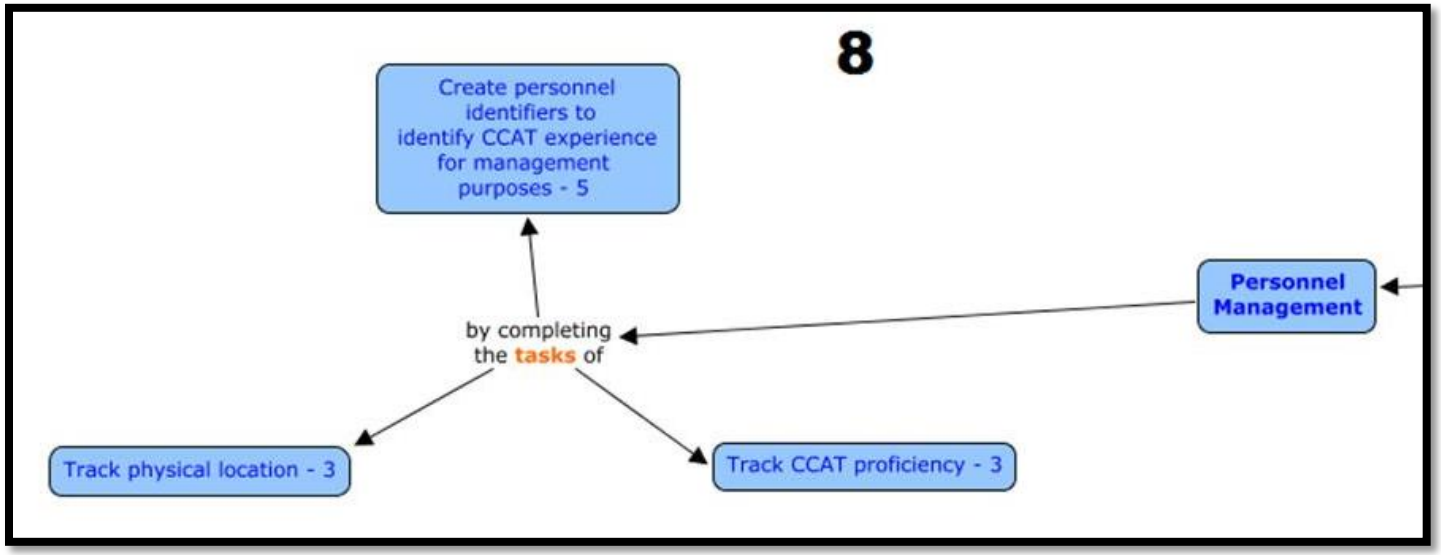

3
Recover/Reset CCAT Operations
that require functions of
Recover from deployment
Recover from mission
Preventing compassion fatigue - 4
by completing the tasks of
Provide personnel resilience - 4
Inventory - Supplies - 0 Medications - 0 Equipment - 0
Recharge personnel - 4
by completing the tasks of
Recharge equipment - 3
Sanitize equipment - 0
Conduct mission debrief - 2
Replenish - Supplies -3 Medications-2 Equipment - 3

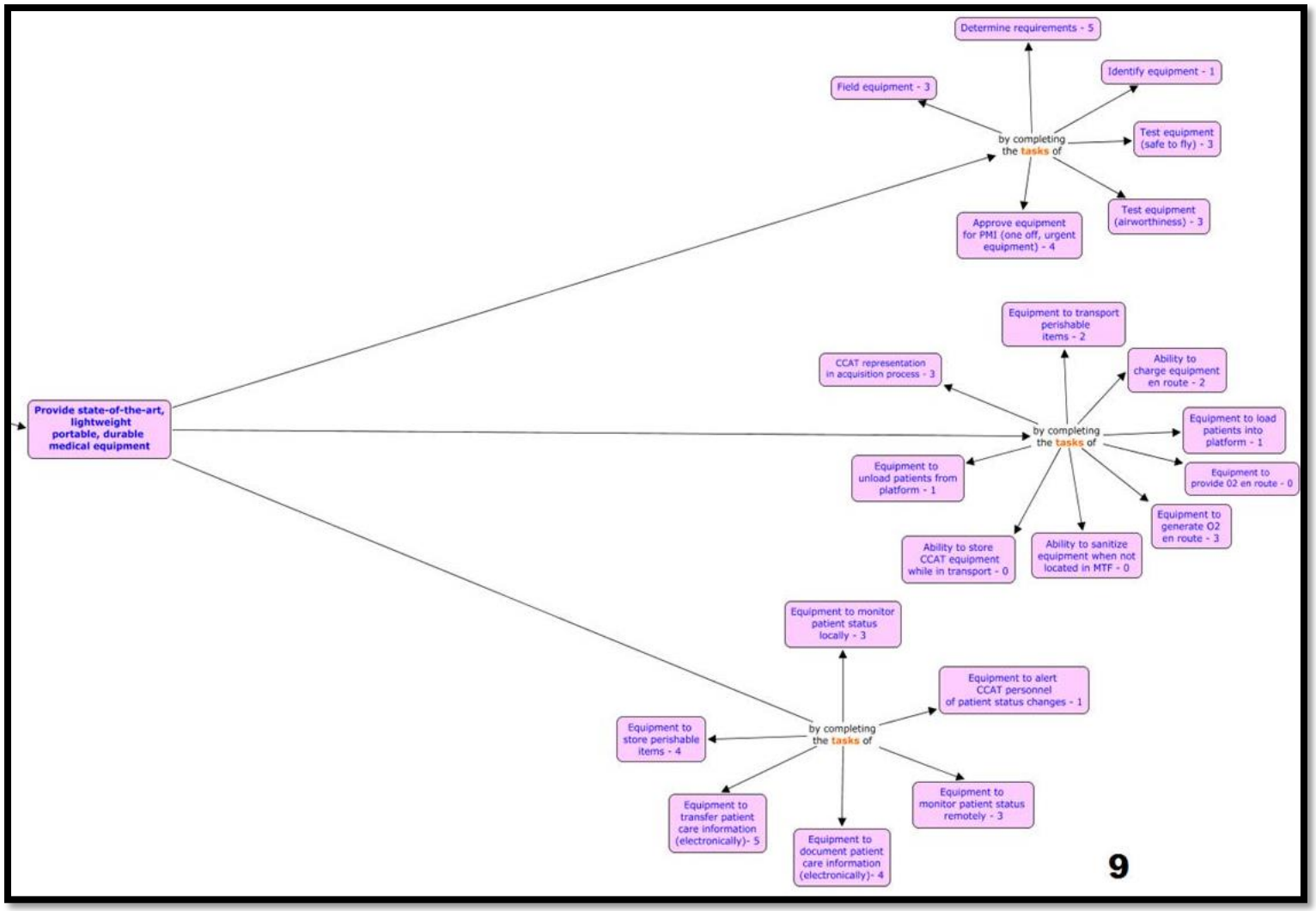

4
Sustain CCAT Operations
that require functions of
Track CCAT equipment location/availability
by completing the tasks of
Track equipment from different locations - 3
Sustain CCAT capabilities between deployments
Maintain critical care proficiency - 5
by completing the tasks of
Maintain equipment - 1
Maintain the ability to operate equipment that is not commonly used MTF setting - 4
Sustain Personnel
by completing the tasks of
Retain personnel - 1
Sustain CCAT capabilities during deployments
by completing the tasks of
Maintain equipment - 3
Maintain critical care proficiency - 2

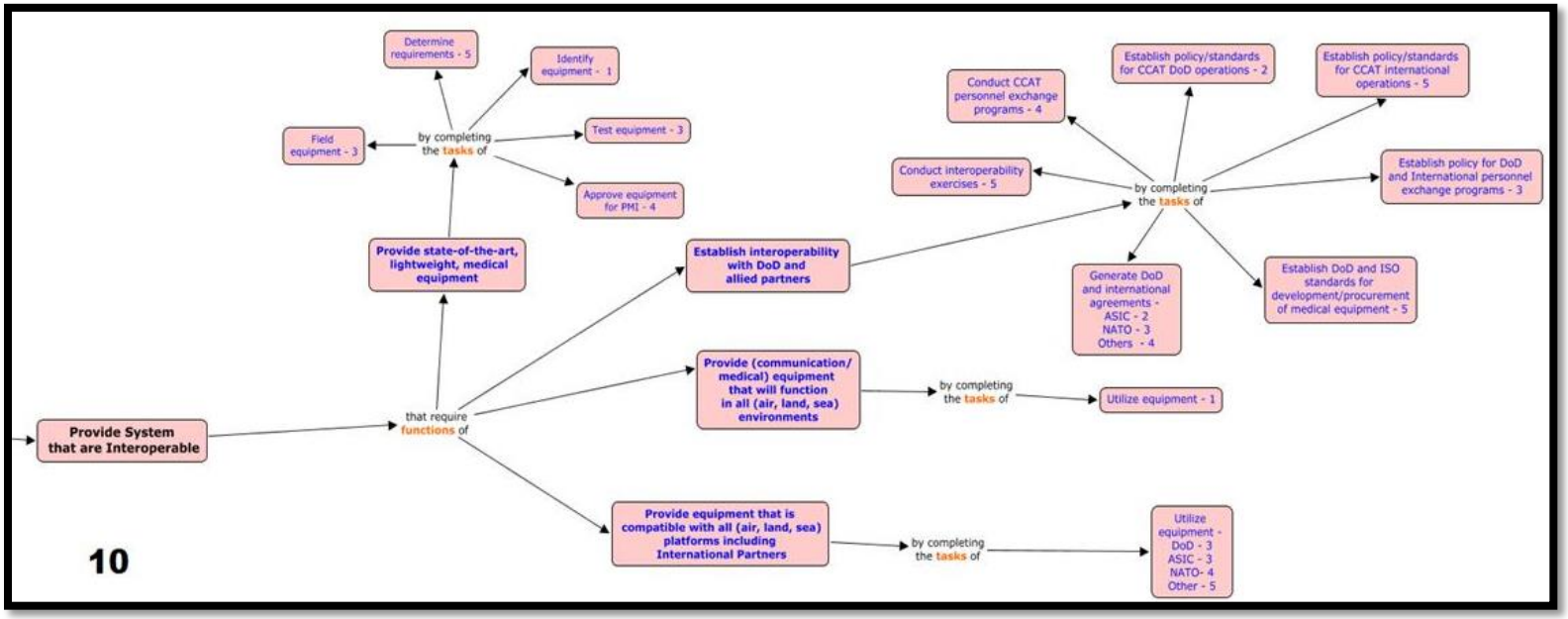

Provide Quality CCAT Teams
5
that require functions of
Determine selection process
by completing the tasks of
Determine selection criteria - 2
Execute selection process
by completing the tasks of
Select CCAT suitable personnel - Physician - 4 Nurse - 2 Respiratory Therapist - 3
Recruit personnel - 2
Identify eligible CCAT personnel - 1
Evaluate eligible CCAT personnel - 3
Assess what needs to be trained
by completing the tasks of
Conduct CCAT task analysis - 2
Conduct analysis of mandatory (non-medical) training requirements - 2
Identify best practices - 4 (CPGs)
Identify mandatory (medical) training requirements - 1
Conduct analysis of mandatory (medical) training requirements - 1
Identify mandatory (non-medical) training requirements - 4
Determine training standards - 2
Assess where to train
by completing the tasks of
Determine facilities for training task - Home station - 1 Deployed - 1
Assess who trains
by completing the tasks of
Determine how many trainers are needed - 0
Determine what qualifications trainers should have - Home station - 4 Formal - 2
Assess how to train
by completing the tasks of
Determine equipment (technology) needed to train - 0
Assess training length
by completing the tasks of
Determine time available versus time required for training - 2

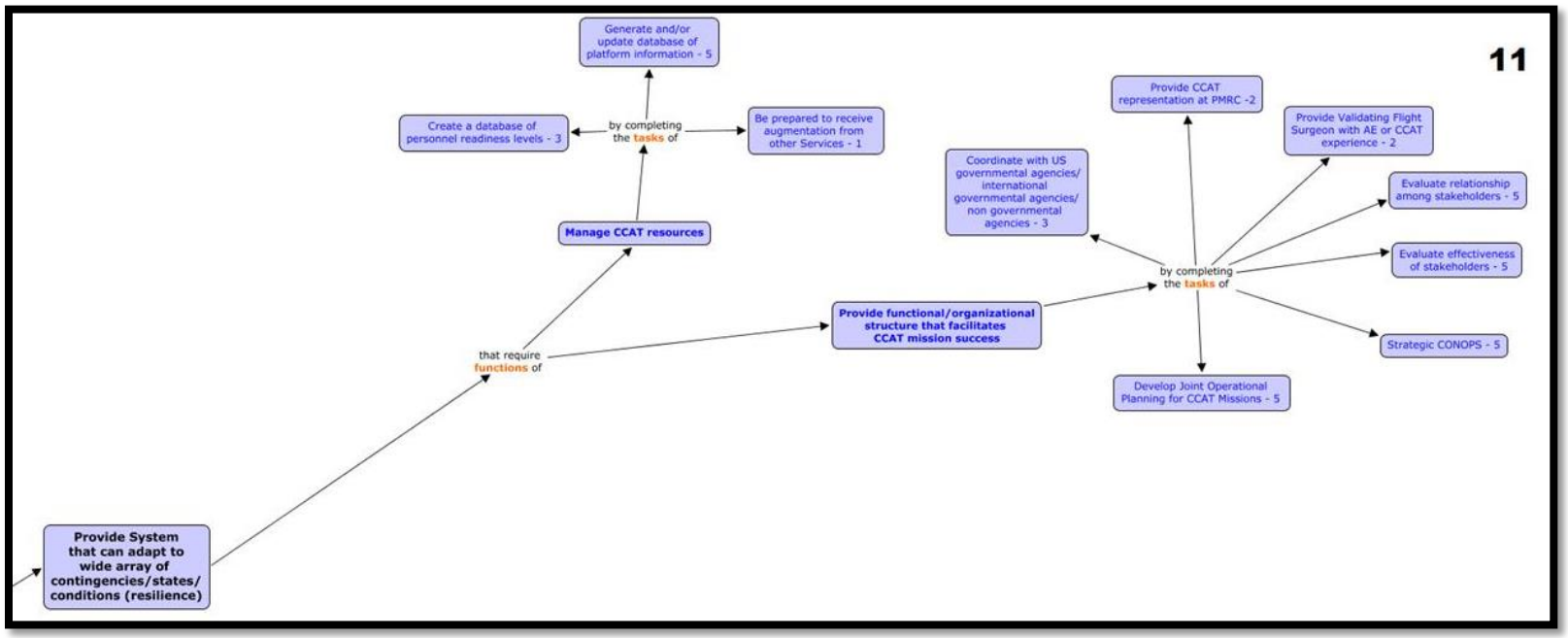

Execute Training
Provide appropriate manpower - 1
Provide facilities Home Station - 1 Formal - 2
Provide qualified instructors - 2
by completing the tasks of
Provide students in a timely manner- 2
Provide curriculum - Home station - 4 Formal - 1
Provide the same equipment (technology) as that used during CCAT operations - Home station - 1 Formal - 1 (still have gaps where told one thing but different downrange)
Devise/Develop Training
Create curriculum to facilitate management fatigue management appropriately - 3
Create curriculum to facilitate the effects of altitude on patient outcome - 4
Create curriculum to facilitate effects of motion vibration, etc. on patient - 4
Create curriculum to familiarize each team member with the roles, responsibilities, and equipment of other team members (cross-training) - 0
by completing the tasks of
Create curriculum to facilitate providing care on rotary, fixed wing, and sea-based platforms (non-standard)- 3
Create curriculum on how to handle equipment failures - 3
Create curriculum to facilitate turn-around procedures - 1
Create curriculum to facilitate patient tracking and documentation - 0
by completing the tasks of
Create curriculum to facilitate risk assessment and mitigation - 2
Create curriculum to facilitate operation of equipment not in the MTF setting - Home station - 2
Create curriculum to facilitate treatment of disaster related injuries (e.g. chemical, nuclear, biological) - 3
Create situation management curriculum (ex. Charge Nurse management experience) - 1
Create objective criteria for evaluating CCAT personnel - 2
Create curriculum that will facilitate operating in all anticipated environments - 2
Create curriculum that will facilitate the ability to work in adverse environments and situations - 2 (adaptability) 4 (exposure to other platforms)
by completing the tasks of
Create critical thinking curriculum - Physician - 1 Nurse - 2 Respiratory Therapist - 3
Create curriculum to facilitate high/low workload situation adaptation - 2
Create curriculum to facilitate performance as a member of a High Performing Team to include AE - 4
6


7
Evaluate Training
Assess curriculum with respect to mission requirements - 1
Evaluate trainers and instructors - 4
by completing the tasks of
Assess students outcomes relative to curriculum requirements - 2
Revise curriculum with respect to mission requirements - 0
Remediate student outcomes relative to curriculum requirements - 3


8
Create personnel identifiers to identify CCAT experience for management purposes - 5
Personnel Management
by completing the tasks of
Track physical location - 3
Track CCAT proficiency - 3


Provide state-of-the-art, lightweight portable, durable medical equipment
by completing the tasks of
Determine requirements - 5
Identify equipment - 1
Test equipment (safe to fly) - 3
Test equipment (airworthiness) - 3
Approve equipment for PMI (one off, urgent equipment) - 4
Field equipment - 3
by completing the tasks of
Equipment to transport perishable items - 2
Ability to charge equipment en route - 2
Equipment to load patients into platform - 1
Equipment to provide 02 en route - 0
Equipment to generate O2 en route - 3
Ability to sanitize equipment when not located in MTF - 0
Ability to store CCAT equipment while in transport - 0
Equipment to unload patients from platform - 1
CCAT representation in acquisition process - 3
by completing the tasks of
Equipment to monitor patient status locally - 3
Equipment to alert CCAT personnel of patient status changes - 1
Equipment to monitor patient status remotely - 3
Equipment to document patient care information (electronically)- 4
Equipment to transfer patient care information (electronically)- 5
Equipment to store perishable items - 4
9


Provide System that are Interoperable
that require functions of
Provide state-of-the-art, lightweight, medical equipment
by completing the tasks of
Determine requirements - 5
Identify equipment - 1
Test equipment - 3
Approve equipment for PMI - 4
Field equipment - 3
Establish interoperability with DoD and allied partners
by completing the tasks of
Conduct CCAT personnel exchange programs - 4
Establish policy/standards for CCAT DoD operations - 2
Establish policy/standards for CCAT international operations - 5
Conduct interoperability exercises - 5
Establish policy for DoD and International personnel exchange programs - 3
Generate DoD and international agreements - ASIC - 2 NATO - 3 Others - 4
Establish DoD and ISO standards for development/procurement of medical equipment - 5
Provide (communication/ medical) equipment that will function in all (air, land, sea) environments
by completing the tasks of
Utilize equipment - 1
Provide equipment that is compatible with all (air, land, sea) platforms including International Partners
by completing the tasks of
Utilize equipment - DoD - 3 ASIC - 3 NATO- 4 Other - 5
10


11
Generate and/or update database of platform information - 5
Create a database of personnel readiness levels - 3
by completing the tasks of
Be prepared to receive augmentation from other Services - 1
Manage CCAT resources
Provide System that can adapt to wide array of contingencies/states/ conditions (resilience)
that require functions of
Provide functional/organizational structure that facilitates CCAT mission success
Coordinate with US governmental agencies/ international governmental agencies/ non governmental agencies - 3
Provide CCAT representation at PMRC -2
Provide Validating Flight Surgeon with AE or CCAT experience - 2
Evaluate relationship among stakeholders - 5
Evaluate effectiveness of stakeholders - 5
by completing the tasks of
Strategic CONOPS - 5
Develop Joint Operational Planning for CCAT Missions - 5

APPENDIX Q. FINALIZED CCAT CBA HTA

The finalized HTA was created by the CCAT CBA analysis team and a version of this table was included in the CCAT CBA final report.

Capability 1: Prepare for CCAT Operation			
Func #	**Function**	**Task #**	**Task**
1.1	Manage Recall Rosters	1.1.1	Updating recall roster at higher levels (HQ)
		1.1.2	Creating recall roster at higher levels (HQ)
		1.1.3	Updating recall roster at MTF (rosters updated monthly)
		1.1.4	Creating recall roster at MTF (rosters updated monthly)
1.2	Prepare for mission	1.2.1	Draw blood and blood products (contingency ops)
		1.2.2	Draw medications
		1.2.3	Collecting all necessary equipment for CCAT operations from staging area
		1.2.4	Loading equipment on platform (need CONOPS)
		1.2.5	Checking equipment for serviceability
		1.2.6	Coordinating with crew to configure non-standard platform
		1.2.7	Coordinating with crew to configure standard platform
		1.2.8	Inventorying equipment
		1.2.9	Transport team/equipment from MTF to airfield
1.3	Receive mission information	1.3.1	Receiving situational information (tactical updates)
		1.3.2	Receiving accurate information concerning patient acuity
		1.3.3	Conducting CCAT operational pre-planning activities
		1.3.4	Ensuring personnel have applicable VISAs and documentation to allow for entry into different countries

Capability 1: Prepare for CCAT Operation			
1.4	Select CCAT personnel based on operational requirements (administrative preparation for CCAT activation)	1.4.1	Determine position and qualifications needed for operation
		1.4.2	Identify eligible CCAT Personnel
		1.4.3	Notify selected CCAT personnel
		1.4.4	Select CCAT personnel for mission

Capability 2: Conduct CCAT Operations			
Func #	**Function**	**Task #**	**Task**
2.1	Care for patients	2.1.1	Accessing patient medical records (regulated/non-regulated)
		2.1.2	En route diagnostics (telemedicine consults)
		2.1.3	Tracking local national patients (regulated/non-regulated)
		2.1.4	Care to patients with infectious diseases
		2.1.5	Tracking DoD/coalition patients (regulated/non-regulated)
		2.1.6	Tracking local national patients during dom ops (regulated/non-regulated)
		2.1.7	Care to critical pediatric patients
		2.1.8	Care to critical neonatal patients
		2.1.9	Care to critically burned patients
		2.1.10	Care to critical geriatric patients
		2.1.11	Care to critically ill patients
		2.1.12	Care to critically injured patients
2.2	Communicate with essential personnel	2.2.1	Providing ability to communicate with non-English speaking personnel
		2.2.2	Communicate with AE Staging Facility
		2.2.3	Strategic communication
		2.2.4	Communicate with CCAT personnel on non-standard platform (intercom, headset, etc.)
		2.2.5	Communicate with CCAT personnel on standard platform (intercom, headset, etc.)
		2.2.6	Communicate with English speaking personnel
		2.2.7	Communicate with MTF
		2.2.8	Communicate with AE team
		2.2.9	Communicate with platform operators
2.3	Document patient information	2.3.1	Update documentation in transit (electronically)
		2.3.2	Receive documentation from pick up location (electronically)

Capability 2: Conduct CCAT Operations			
Func #	**Function**	**Task #**	**Task**
	Document patient information	2.3.3	Transfer documentation when transferring patient (electronically)
2.4	Enable immediate access to information	2.4.1	Access medical information (reference database) at all times
		2.4.2	Access information for mission plan at all times
2.5	Function as a High Performing Team	2.5.1	Establishing team shared mental models
		2.5.2	Establishing communication between team members
		2.5.3	Executing Crew Resource Management skills
2.6	Transport patients in any platform	2.6.1	Safely load and offload patients into non-standard platform (personnel focus)
		2.6.2	Safely load and offload patients into standard platform (personnel focus)
		2.6.3	Secure patients for movement

Capability 3: Recover/Reset CCAT Operations			
Func #	**Function**	**Task #**	**Task**
3.1	Recover from deployment	3.1.1	Provide personnel resilience
		3.1.2	Preventing compassion fatigue
3.2	Recover from mission	3.2.1	Recharge personnel
		3.2.2	Replenish supplies
		3.2.3	Replenish medications
		3.2.4	Replenish equipment
		3.2.5	Conduct mission debrief
		3.2.6	Recharge equipment
		3.2.7	Sanitize equipment
		3.2.8	Inventory supplies
		3.2.9	Inventory medications
		3.2.10	Inventory equipment

Capability 4: Sustain CCAT Operations			
Func #	**Function**	**Task #**	**Task**
4.1	Sustain CCAT capabilities between deployments	4.1.1	Maintain critical care proficiency
		4.1.2	Maintain the ability to operate equipment that is not commonly used in the MTF setting
		4.1.3	Maintain equipment
4.2	Sustain CCAT capabilities during deployments	4.2.1	Maintain equipment
		4.2.2	Maintain critical care proficiency
4.3	Sustain CCAT personnel	4.3.1	Retain CCAT personnel
4.4	Track CCAT equipment location/availability	4.4.1	Track equipment from different locations

Capability 5: Provide Qualified CCAT Teams			
Func #	**Function**	**Task #**	**Task**
5.1	Assess how to train	5.1.1	Determine equipment (technology) needed to train
5.2	Assess training length	5.2.1	Determine time available versus time required for training
5.3	Assess what needs to be trained	5.3.1	Conduct CCAT task analysis
		5.3.2	Identify best practices (CPGs)
		5.3.3	Identify mandatory (non-medical) training requirements
		5.3.4	Conduct analysis of mandatory (non-medical) training requirements
		5.3.5	Determine training standards
		5.3.6	Conduct analysis of mandatory (medical) training requirements
		5.3.7	Identify mandatory (medical) training requirements
5.4	Assess where to train	5.4.1	Determine facilities for training task at home station
		5.4.2	Determine facilities for training task while deployed
5.5	Assess who trains	5.5.1	Determine what qualifications trainers should have for home station training
		5.5.2	Determine what qualifications trainers should have formal training
		5.5.3	Determine how many trainers are needed
5.6	Determine selection process	5.6.1	Determine selection criteria
5.7	Devise/Develop Training	5.7.1	Create critical thinking curriculum for respiratory therapist
		5.7.2	Create situation management curriculum (ex. Charge Nurse mgmt. experience)
		5.7.3	Create critical thinking curriculum for physician
		5.7.4	Create curriculum that will facilitate operating in all anticipated environments
		5.7.5	Create curriculum to facilitate the effects of altitude on patient outcome
		5.7.6	Create curriculum to facilitate fatigue management appropriately
		5.7.7	Create critical thinking curriculum for nurse
		5.7.8	Create curriculum to facilitate effects of motion, vibration, etc. on patients

Capability 5: Provide Qualified CCAT Teams			
Func #	**Function**	**Task #**	**Task**
5.7	Devise/Develop Training	5.7.9	Create curriculum to facilitate performance as a member of a high performing team to include AE (i.e. crew resource management)
		5.7.10	Create curriculum that will facilitate the ability to work in adverse environments and situations specifically for exposure to other platforms
		5.7.11	Create curriculum to facilitate treatment of disaster related injuries (e.g. chemical, nuclear, biological)
		5.7.12	Create curriculum to facilitate providing care on rotary, fixed wing, and sea-based platforms (non-standard)
		5.7.13	Create curriculum to facilitate operation of CCAT equipment not used in the MTF setting
		5.7.14	Create curriculum that will facilitate the ability to work in adverse environments and situations specifically for adaptability
		5.7.15	Create curriculum on how to handle equipment failures
		5.7.16	Create objective criteria for evaluating CCAT personnel
		5.7.17	Create curriculum to facilitate risk assessment and mitigation
		5.7.18	Create curriculum to familiarize each team member with the roles, responsibilities, and equipment of other team members (cross-training)
		5.7.19	Create curriculum to facilitate patient tracking and documentation
		5.7.20	Create curriculum to facilitate turn-around procedures
		5.7.21	Create curriculum to facilitate high/low workload situation adaptation
5.8	Evaluate training	5.8.1	Evaluate trainers and instructors
		5.8.2	Remediate student outcomes relative to curriculum requirements
		5.8.3	Assess curriculum with respect to mission requirements
		5.8.4	Assess students outcomes relative to curriculum requirements
		5.8.5	Revise curriculum with respect to mission requirements

Capability 5: Provide Qualified CCAT Teams			
Func #	**Function**	**Task #**	**Task**
5.9	Execute selection process	5.9.1	Select suitable CCAT physician
		5.9.2	Select suitable CCAT respiratory therapist
		5.9.3	Select suitable CCAT nurse
		5.9.4	Evaluate eligible CCAT personnel
		5.9.5	Recruit personnel
		5.9.6	Identify eligible CCAT personnel
5.10	Execute Training	5.10.1	Provide appropriate manpower
		5.10.2	Provide the same equipment (technology) as that used during CCAT operations at home station
		5.10.3	Provide appropriately experienced and qualified instructors
		5.10.4	Provide facilities for formal training
		5.10.5	Provide curriculum for home station training
		5.10.6	Provide students in a timely manner
		5.10.7	Provide facilities for home station training
		5.10.8	Provide the same equipment (technology) as that used during CCAT operations at formal training
		5.10.9	Provide curriculum for formal training
5.11	Personnel Management	5.11.1	Create personnel identifiers to identify CCAT experience for management purposes
		5.11.2	Track CCAT proficiency
		5.11.3	Track physical location
5.12	Sustain CCAT personnel	5.12.1	Retain CCAT personnel

Capability 6: Provide equipment to CCAT teams			
Func #	**Function**	**Task #**	**Task**
6.1	Provide state-of-the-art lightweight portable, durable, medical equipment	6.1.1	Determine requirements
		6.1.2	Equipment to store perishable items (contingency ops)
		6.1.3	Equipment to monitor patient status remotely
		6.1.4	Equipment to document patient care information (electronically)
		6.1.5	Equipment to transfer patient care information (electronically)
		6.1.6	Equipment to generate O2 en route
		6.1.7	CCAT representation in acquisition process
		6.1.8	Equipment to monitor patient status locally
		6.1.9	Identify equipment
		6.1.10	Ability to charge equipment en route
		6.1.11	Equipment to transport perishable items
		6.1.12	Equipment to alert CCAT personnel of patient status changes
		6.1.13	Test equipment (airworthiness)
		6.1.14	Equipment to provide O2 en route
		6.1.15	Test equipment (safe to fly)
		6.1.16	Approve equipment for PMI (one off, urgent equipment)
		6.1.17	Field equipment
		6.1.18	Equipment to load patients into platform
		6.1.19	Equipment to unload patients from platform
		6.1.20	Ability to sanitize equipment when not located at MTF
		6.1.21	Ability to store CCAT equipment while in transport

Capability 7: Provide system that is interoperable			
Func #	**Function**	**Task #**	**Task**
7.1	Establish interoperability with DoD and allied partners	7.1.1	Establish policy/standards for CCAT international operations
		7.1.2	Establish DoD and ISO standards for development/procurement of medical equipment
		7.1.3	Generate DoD and international agreements other international agencies
		7.1.4	Conduct interoperability exercises
		7.1.5	Establish policy for DoD and International personnel exchange programs
		7.1.6	Conduct CCAT personnel exchange programs
		7.1.7	Generate DoD and international agreements for NATO
		7.1.8	Generate DoD and international agreements for ASIC
		7.1.9	Establish policy/standards for CCAT DoD operations
7.2	Provide (communication/ medical) equipment that will function in all (air, land, sea) environments	7.2.1	Utilize equipment
7.3	Provide equipment that is compatible with all (air, land, sea) platforms including International Partners	7.3.1	Utilize equipment for other international agencies
		7.3.2	Utilize equipment for NATO
		7.3.3	Utilize equipment for ASIC
		7.3.4	Utilize equipment for DoD
7.4	Provide state-of-the-art lightweight portable, durable, medical equipment	7.4.1	Determine requirements
		7.4.2	Identify equipment
		7.4.3	Test equipment (airworthiness)
		7.4.4	Test equipment (safe to fly)
		7.4.5	Approve equipment for PMI (one off, urgent equipment)
		7.4.6	Field equipment

Capability 8: Provide system that can adapt to wide array of contingencies/states/ conditions (resilience)			
Func #	**Function**	**Task #**	**Task**
8.1	Manage CCAT resources	8.1.1	Generate and/or update database of platform information
		8.1.2	Create database of personnel readiness levels
		8.1.3	Be prepared to receive augmentation from other Services
8.2	Provide functional/organizational structure that facilitates CCAT mission success	8.2.1	Strategic CONOPS
		8.2.2	Evaluate relationship among stakeholders (e.g. AD, ANG, AFRC, professional groups, AFMS, A3, SG, etc.)
		8.2.3	Evaluate effectiveness of stakeholders (e.g. AD, ANG, AFRC, professional groups, AFMS, A3, SG, etc.) working together
		8.2.4	Develop Joint Operational Planning for CCAT Missions
		8.2.5	Coordinate with US governmental agencies/international governmental agencies/non-governmental agencies
		8.2.6	Provide Validating Flight Surgeon with AE or CCAT experience
		8.2.7	Provide CCAT representation at PMRC/CAOC

APPENDIX R. RISK RATING VERIFICATION AND COMPARISON

The CCAT CBA analysis team created the Risk Rating Verification and Comparison table.

	Likelihood								Severity							
Task #	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference (Team vs SME)	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference(Team vs SME)
4.1.1	0.7	3	0.7	0.7	0.9	0.9	0.77	-0.07	10	3	10	10	10	10	10.00	0.00
5.9.1	0.8	3	0.8	0.8	0.6	0.8	0.73	0.07	9	3	9	9	10	10	9.33	-0.33
5.10.1	0.8	2	0.8	0.8		0.8	0.80	0.00	7	2	7	9		9	8.00	-1.00
6.1.7	0.7	2	0.7	0.7		0.7	0.70	0.00	9	2	9	9		9	9.00	0.00
5.9.2	0.7	3	0.7	0.7	0.8	0.8	0.73	-0.03	7	3	7	7	10	10	8.00	-1.00
6.1.1	0.8	2	0.8	0.8		0.8	0.80	0.00	7	2	7	7		7	7.00	0.00
7.4.1	0.8	2	0.8	0.8		0.8	0.80	0.00	7	2	7	7		7	7.00	0.00
5.7.5	0.6	2	0.6	0.6		0.6	0.60	0.00	9	2	9	9		9	9.00	0.00
6.1.8	0.6	2	0.6	0.6		0.6	0.60	0.00	9	2	9	9		9	9.00	0.00
7.1.1	0.8	3	0.8	0.8	0.8	0.8	0.80	0.00	6	3	6	7	7	7	6.67	-0.67
5.10.2	0.7	2	0.7	0.7		0.7	0.70	0.00	7	2	7	8		8	7.50	-0.50
5.10.3	0.7	2	0.7	0.7		0.7	0.70	0.00	7	2	7	7		7	7.00	0.00
5.3.1	0.8	3	0.8	0.8	0.8	0.8	0.80	0.00	5	3	5	5	8	8	6.00	-1.00
6.1.2	0.8	2	0.8	0.8		0.8	0.80	0.00	6	2	6	6		6	6.00	0.00
2.2.1	0.8	2	0.8	0.5		0.8	0.65	0.15	7	2	7	7		7	7.00	0.00
8.2.1	0.9	2	0.9	0.4		0.9	0.65	0.25	6	2	6	8		8	7.00	-1.00
1.1.1	0.7	2	0.7	0.7		0.7	0.70	0.00	4	2	4	9		9	6.50	-2.50
2.6.1	0.5	2	0.5	0.5		0.5	0.50	0.00	9	2	9	9		9	9.00	0.00
5.9.3	0.6	3	0.6	0.6	0.6	0.6	0.60	0.00	6	3	6	6	10	10	7.33	-1.33
7.1.2	0.8	3	0.8	0.8	0.8	0.8	0.80	0.00	5	3	5	5	6	6	5.33	-0.33
5.3.2	0.7	3	0.7	0.7	0.5	0.7	0.63	0.07	6	3	6	6	8	8	6.67	-0.67
4.1.2	0.6	3	0.6	0.6	0.6	0.6	0.60	0.00	7	3	7	7	7	7	7.00	0.00
5.7.6	0.6	2	0.6	0.6		0.6	0.60	0.00	7	2	7	7		7	7.00	0.00
5.8.1	0.6	3	0.6	0.6	0.6	0.6	0.60	0.00	7	3	7	7	7	7	7.00	0.00
2.2.3	0.5	2	0.5	0.5		0.5	0.50	0.00	8	2	8	8		8	8.00	0.00

	Likelihood								Severity							
Task #	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference (Team vs SME)	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference(Team vs SME)
3.1.1	0.5	3	0.5	0.5	0.5	0.5	0.50	0.00	8	3	8	8	8	8	8.00	0.00
5.9.4	0.5	3	0.5	0.5	0.5	0.5	0.50	0.00	8	3	8	8	8	8	8.00	0.00
6.1.3	0.8	2	0.8	0.8		0.8	0.80	0.00	5	2	5	5		5	5.00	0.00
6.1.4	0.8	2	0.8	0.8		0.8	0.80	0.00	5	2	5	5		5	5.00	0.00
6.1.5	0.8	2	0.8	0.8		0.8	0.80	0.00	5	2	5	5		5	5.00	0.00
8.1.1	0.7	2	0.7	0.9		0.9	0.80	-0.10	5	2	5	5		5	5.00	0.00
3.2.1	0.5	3	0.5	0.5	0.7	0.7	0.57	-0.07	7	3	7	7	7	7	7.00	0.00
5.5.1	0.5	3	0.5	0.5	0.5	0.5	0.50	0.00	7	3	7	7	9	9	7.67	-0.67
7.3.4	0.5	3	0.5	0.5	0.5	0.5	0.50	0.00	7	3	7	8	8	8	7.67	-0.67
7.1.3	0.7	3	0.7	0.7	0.7	0.7	0.70	0.00	5	3	5	5	6	6	5.33	-0.33
7.1.4	0.7	3	0.7	0.7	0.7	0.7	0.70	0.00	5	3	5	5	6	6	5.33	-0.33
2.6.2	0.4	2	0.4	0.4		0.4	0.40	0.00	9	2	9	9		9	9.00	0.00
1.3.2	0.6	2	0.6	0.6		0.6	0.60	0.00	6	2	6	6		6	6.00	0.00
5.8.2	0.6	3	0.6	0.6	0.6	0.6	0.60	0.00	6	3	6	6	6	6	6.00	0.00
8.2.2	0.6	2	0.6	0.6		0.6	0.60	0.00	7	2	7	5		7	6.00	1.00
8.2.3	0.6	2	0.6	0.6		0.6	0.60	0.00	7	2	7	5		7	6.00	1.00
5.7.1	0.8	2	0.8	0.8		0.8	0.80	0.00	4	2	4	5		5	4.50	-0.50
5.11.1	0.7	3	0.7	0.7	0.7	0.7	0.70	0.00	5	3	5	5	5	5	5.00	0.00
1.1.2	0.5	2	0.5	0.5		0.5	0.50	0.00	6	2	8	5		8	6.50	-0.50
5.7.9	0.5	2	0.5	0.5		0.5	0.50	0.00	7	2	7	6		7	6.50	0.50
5.7.11	0.4	3	0.4	0.4	0.4	0.4	0.40	0.00	8	3	8	8	8	8	8.00	0.00
7.1.5	0.6	3	0.6	0.6	0.6	0.6	0.60	0.00	6	3	6	3	7	7	5.33	0.67
7.3.3	0.6	3	0.6	0.6	0.6	0.6	0.60	0.00	5	3	5	5	6	6	5.33	-0.33
5.7.2	0.8	2	0.8	0.8		0.8	0.80	0.00	4	2	4	4		4	4.00	0.00
7.1.7	0.5	3	0.5	0.5	0.5	0.5	0.50	0.00	6	3	6	6	7	7	6.33	-0.33
5.10.5	0.2	2	0.2	0.7		0.7	0.45	-0.25	5	2	5	9		9	7.00	-2.00
5.7.3	0.7	2	0.7	0.7		0.7	0.70	0.00	4	2	4	5		5	4.50	-0.50
7.3.2	0.7	3	0.7	0.7	0.7	0.7	0.70	0.00	4	3	4	4	5	5	4.33	-0.33
5.10.4	0.5	2	0.5	0.5		0.5	0.50	0.00	6	2	6	6		6	6.00	0.00
6.1.9	0.5	2	0.5	0.5		0.5	0.50	0.00	6	2	6	6		6	6.00	0.00

	Likelihood								Severity							
Task #	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference (Team vs SME)	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference(Team vs SME)
7.4.2	0.5	2	0.5	0.5		0.5	0.50	0.00	6	2	6	6		6	6.00	0.00
7.1.8	0.4	3	0.4	0.4	0.4	0.4	0.40	0.00	7	3	7	7	8	8	7.33	-0.33
1.3.1	0.7	2	0.7	0.7		0.7	0.70	0.00	4	2	4	4		4	4.00	0.00
5.11.2	0.7	3	0.7	0.7	0.7	0.7	0.70	0.00	4	3	4	4	4	4	4.00	0.00
5.7.7	0.6	2	0.6	0.6		0.6	0.60	0.00	4	2	4	5		5	4.50	-0.50
3.1.2	0.4	3	0.4	0.4	0.4	0.4	0.40	0.00	7	3	7	7	6	7	6.67	0.33
7.3.1	0.8	3	0.8	0.8	0.8	0.8	0.80	0.00	3	3	3	3	4	4	3.33	-0.33
5.5.2	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	8	3	8	8	9	9	8.33	-0.33
4.2.1	0.5	3	0.5	0.5	0.5	0.5	0.50	0.00	5	3	5	5	5	5	5.00	0.00
4.4.1	0.5	3	0.5	0.5	0.5	0.5	0.50	0.00	5	3	5	5	5	5	5.00	0.00
6.1.10	0.5	2	0.5	0.5		0.5	0.50	0.00	5	2	5	5		5	5.00	0.00
8.2.4	0.7	2	0.7	0.3		0.7	0.50	0.20	5	2	5	5		5	5.00	0.00
2.1.1	0.7	2	0.7	0.7		0.7	0.70	0.00	2	2	5	2		5	3.50	-1.50
1.2.1	0.3	2	0.3	0.3		0.3	0.30	0.00	8	2	8	8		8	8.00	0.00
1.2.2	0.3	2	0.3	0.3		0.3	0.30	0.00	8	2	8	8		8	8.00	0.00
2.1.4	0.3	2	0.3	0.3		0.3	0.30	0.00	8	2	8	8		8	8.00	0.00
4.1.3	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	8	3	8	8	8	8	8.00	0.00
5.7.12	0.4	2	0.4	0.4		0.4	0.40	0.00	4	2	4	8		8	6.00	-2.00
5.9.5	0.4	3	0.4	0.4	0.4	0.4	0.40	0.00	6	3	6	6	6	6	6.00	0.00
6.1.11	0.4	2	0.4	0.4		0.4	0.40	0.00	6	2	6	6		6	6.00	0.00
8.2.6	0.6	2	0.6	0.2		0.6	0.40	0.20	3	2	3	9		9	6.00	-3.00
2.2.2	0.6	2	0.6	0.6		0.6	0.60	0.00	4	2	4	4		4	4.00	0.00
5.7.8	0.6	2	0.6	0.6		0.6	0.60	0.00	4	2	4	4		4	4.00	0.00
7.1.6	0.7	3	0.7	0.7	0.4	0.7	0.60	0.10	4	3	4	3	5	5	4.00	0.00
2.4.1	0.8	2	0.8	0.8		0.8	0.80	0.00	3	2	3	3		3	3.00	0.00
6.1.6	0.8	2	0.8	0.8		0.8	0.80	0.00	3	2	3	3		3	3.00	0.00
2.5.2	0.4	2	0.4	0.3		0.4	0.35	0.05	7	2	7	6		7	6.50	0.50
2.5.3	0.4	2	0.4	0.3		0.4	0.35	0.05	7	2	7	6		7	6.50	0.50
5.7.13	0.5	3	0.5	0.5	0.2	0.5	0.40	0.10	5	3	5	5	7	7	5.67	-0.67
5.7.10	0.5	2	0.5	0.5		0.5	0.50	0.00	4	2	4	5		5	4.50	-0.50

	Likelihood								Severity							
Task #	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference (Team vs SME)	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference(Team vs SME)
5.12.1	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	7	3	7	8	7	8	7.33	-0.33
3.2.2	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	7	3	7	7	7	7	7.00	0.00
3.2.3	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	7	3	7	7	7	7	7.00	0.00
3.2.4	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	7	3	7	7	7	7	7.00	0.00
5.7.4	0.7	2	0.7	0.7		0.7	0.70	0.00	3	2	3	3		3	3.00	0.00
8.2.5	0.5	2	0.5	0.5		0.5	0.50	0.00	4	2	4	4		4	4.00	0.00
6.1.12	0.2	2	0.2	0.2		0.2	0.20	0.00	9	2	9	9		9	9.00	0.00
2.5.1	0.5	2	0.5	0.3		0.5	0.40	0.10	3	2	3	6		6	4.50	-1.50
2.1.2	0.7	2	0.7	0.7		0.7	0.70	0.00	3	2	3	2		3	2.50	0.50
1.2.3	0.2	2	0.2	0.2		0.2	0.20	0.00	9	2	9	8		9	8.50	0.50
1.2.4	0.2	2	0.2	0.2		0.2	0.20	0.00	8	2	8	8		8	8.00	0.00
1.2.5	0.2	2	0.2	0.2		0.2	0.20	0.00	8	2	8	8		8	8.00	0.00
1.4.1	0.2	2	0.2	0.2		0.2	0.20	0.00	8	2	8	8		8	8.00	0.00
4.2.2	0.2	3	0.2	0.2	0.4	0.4	0.27	-0.07	6	3	6	6	6	6	6.00	0.00
5.3.5	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	7	3	7	7	9	9	7.67	-0.67
1.4.2	0.2	2	0.2	0.2		0.2	0.20	0.00	7	2	7	8		8	7.50	-0.50
2.2.4	0.3	2	0.3	0.3		0.3	0.30	0.00	5	2	5	5		5	5.00	0.00
5.10.6	0.3	2	0.3	0.3		0.3	0.30	0.00	5	2	5	5		5	5.00	0.00
5.11.3	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	5	3	5	5	5	5	5.00	0.00
5.8.3	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	4	3	4	4	7	7	5.00	-1.00
2.3.1	0.5	2	0.5	0.5		0.5	0.50	0.00	3	2	3	3		3	3.00	0.00
5.3.3	0.4	3	0.4	0.4	0.4	0.4	0.40	0.00	3	3	3	3	5	5	3.67	-0.67
1.1.3	0.2	2	0.2	0.2		0.2	0.20	0.00	5	2	5	9		9	7.00	-2.00
1.2.6	0.2	2	0.2	0.2		0.2	0.20	0.00	7	2	7	7		7	7.00	0.00
1.2.7	0.2	2	0.2	0.2		0.2	0.20	0.00	7	2	7	7		7	7.00	0.00
2.3.3	0.2	2	0.2	0.2		0.2	0.20	0.00	7	2	7	7		7	7.00	0.00
2.6.3	0.2	2	0.2	0.2		0.2	0.20	0.00	7	2	7	7		7	7.00	0.00
5.8.4	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	7	3	7	7	7	7	7.00	0.00
6.1.13	0.2	2	0.2	0.2		0.2	0.20	0.00	7	2	7	7		7	7.00	0.00
7.4.3	0.2	2	0.2	0.2		0.2	0.20	0.00	7	2	7	7		7	7.00	0.00

	Likelihood								Severity							
Task #	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference (Team vs SME)	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference(Team vs SME)
2.4.2	0.7	2	0.7	0.7		0.7	0.70	0.00	2	2	2	2		2	2.00	0.00
3.2.5	0.3	3	0.3	0.3	0.3	0.3	0.30	0.00	5	3	5	5	3	5	4.33	0.67
2.1.3	0.5	2	0.5	0.5		0.5	0.50	0.00	3	2	3	2		3	2.50	0.50
3.2.6	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	6	3	6	6	6	6	6.00	0.00
4.3.1	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	6	3	6	6	6	6	6.00	0.00
5.6.1	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	5	3	5	5	8	8	6.00	-1.00
8.2.7	0.2	2	0.2	0.2		0.2	0.20	0.00	4	2	4	8		8	6.00	-2.00
8.1.3	0.3	2	0.3	0.3		0.3	0.30	0.00	3	2	3	5		5	4.00	-1.00
8.1.2	0.4	2	0.4	0.4		0.4	0.40	0.00	3	2	3	3		3	3.00	0.00
7.2.1	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	4	3	4	8	5	8	5.67	-1.67
5.7.14	0.2	2	0.2	0.2		0.2	0.20	0.00	5	2	5	6		6	5.50	-0.50
5.3.4	0.2	3	0.2	0.2	0.5	0.5	0.30	-0.10	3	3	3	3	5	5	3.67	-0.67
5.8.5	0.1	3	0.1	0.1	0.3	0.3	0.17	-0.07	6	3	6	6	7	7	6.33	-0.33
5.3.6	0.1	3	0.1	0.1	0.2	0.2	0.13	-0.03	7	3	7	7	9	9	7.67	-0.67
6.1.14	0.1	2	0.1	0.1		0.1	0.10	0.00	10	2	10	10		10	10.00	0.00
5.10.7	0.2	2	0.2	0.2		0.2	0.20	0.00	5	2	5	5		5	5.00	0.00
5.7.15	0.2	2	0.2	0.2		0.2	0.20	0.00	5	2	5	5		5	5.00	0.00
2.3.2	0.5	2	0.5	0.5		0.5	0.50	0.00	2	2	2	2		2	2.00	0.00
1.4.3	0.1	2	0.1	0.1		0.1	0.10	0.00	9	2	9	10		10	9.50	-0.50
2.1.7	0.1	2	0.1	0.1		0.1	0.10	0.00	9	2	9	9		9	9.00	0.00
2.1.8	0.1	2	0.1	0.1		0.1	0.10	0.00	9	2	9	9		9	9.00	0.00
5.10.8	0.1	2	0.1	0.1		0.1	0.10	0.00	9	2	9	9		9	9.00	0.00
2.1.10	0.1	2	0.1	0.1		0.1	0.10	0.00	8	2	8	8		8	8.00	0.00
2.1.9	0.1	2	0.1	0.1		0.1	0.10	0.00	8	2	8	8		8	8.00	0.00
5.1.1	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	8	3	8	8	8	8	8.00	0.00
5.9.6	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	8	3	8	8	8	8	8.00	0.00
1.3.4	0.2	2	0.2	0.2		0.2	0.20	0.00	3	2	3	5		5	4.00	-1.00
2.1.5	0.2	2	0.2	0.2		0.2	0.20	0.00	2	2	5	3		5	4.00	-2.00
5.2.1	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	4	3	4	4	4	4	4.00	0.00
5.7.16	0.2	2	0.2	0.2		0.2	0.20	0.00	4	2	4	4		4	4.00	0.00

	Likelihood								Severity							
Task #	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference (Team vs SME)	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference(Team vs SME)
1.3.3	0.4	2	0.4	0.4		0.4	0.40	0.00	2	2	2	2		2	2.00	0.00
5.3.7	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	7	3	7	7	9	9	7.67	-0.67
1.2.8	0.1	2	0.1	0.1		0.1	0.10	0.00	7	2	7	8		8	7.50	-0.50
3.2.7	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	8	3	8	8	6	8	7.33	0.67
2.1.11	0.1	2	0.1	0.1		0.1	0.10	0.00	7	2	7	7		7	7.00	0.00
2.1.12	0.1	2	0.1	0.1		0.1	0.10	0.00	7	2	7	7		7	7.00	0.00
3.2.10	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	7	3	7	7	7	7	7.00	0.00
3.2.8	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	7	3	7	7	7	7	7.00	0.00
3.2.9	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	7	3	7	7	7	7	7.00	0.00
6.1.15	0.1	2	0.1	0.1		0.1	0.10	0.00	7	2	7	7		7	7.00	0.00
7.4.4	0.1	2	0.1	0.1		0.1	0.10	0.00	7	2	7	7		7	7.00	0.00
6.1.16	0.1	2	0.1	0.1		0.1	0.10	0.00	6	2	6	6		6	6.00	0.00
7.1.9		1	0.1			0.1	0.10	0.90		1	6			6	6.00	-6.00
7.4.5	0.1	2	0.1	0.1		0.1	0.10	0.00	6	2	6	6		6	6.00	0.00
2.1.6	0.5	1	0.2			0.2	0.20	0.30		1	3			3	3.00	-3.00
5.7.17	0.2	3	0.2	0.2	0.2	0.2	0.20	0.00	3	3	3	3	3	3	3.00	0.00
2.2.5	0.1	2	0.1	0.1		0.1	0.10	0.00	5	2	5	5		5	5.00	0.00
5.10.9	0.1	2	0.1	0.1		0.1	0.10	0.00	5	2	5	5		5	5.00	0.00
5.7.18	0.1	2	0.1	0.1		0.1	0.10	0.00	5	2	5	5		5	5.00	0.00
6.1.17	0.1	2	0.1	0.1		0.1	0.10	0.00	5	2	5	5		5	5.00	0.00
7.4.6	0.1	2	0.1	0.1		0.1	0.10	0.00	5	2	5	5		5	5.00	0.00
5.7.19	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	4	3	4	4	4	4	4.00	0.00
5.7.20	0.1	2	0.1	0.1		0.1	0.10	0.00	3	2	3	3		3	3.00	0.00
6.1.18	0.1	2	0.1	0.1		0.1	0.10	0.00	3	2	3	3		3	3.00	0.00
6.1.19	0.1	2	0.1	0.1		0.1	0.10	0.00	3	2	3	3		3	3.00	0.00
5.7.21	0.1	2	0.1	0.1		0.1	0.10	0.00	2	2	2	3		3	2.50	-0.50
5.4.1	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	2	3	2	2	2	2	2.00	0.00
5.4.2	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	2	3	2	2	2	2	2.00	0.00
5.5.3	0.1	3	0.1	0.1	0.1	0.1	0.10	0.00	2	3	2	2	2	2	2.00	0.00
6.1.20	0.1	2	0.1	0.1		0.1	0.10	0.00	2	2	2	2		2	2.00	0.00

	Likelihood								Severity							
Task #	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference (Team vs SME)	Team's Ratings	Number of SME inputs	SME 1	SME 2	SME 3	Worst Case	Average	Avg Difference(Team vs SME)
6.1.21	0.1	2	0.1	0.1		0.1	0.10	0.00	2	2	2	2		2	2.00	0.00
2.2.6	0.1	2	0.1	0.1		0.1	0.10	0.00	1	2	1	1		1	1.00	0.00
1.2.9	0	2	0	0		0	0.00	0.00	10	2	10	10		10	10.00	0.00
1.4.4	0	2	0	0		0	0.00	0.00	10	2	10	10		10	10.00	0.00
2.2.7	0	2	0	0		0	0.00	0.00	8	2	8	8		8	8.00	0.00
1.1.4	0	2	0	0		0	0.00	0.00	7	2	7	8		8	7.50	-0.50
2.2.8	0	2	0	0		0	0.00	0.00	3	2	3	3		3	3.00	0.00
2.2.9	0	2	0	0		0	0.00	0.00	3	2	3	3		3	3.00	0.00

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APPENDIX S. RISK RANKINGS

The Risk Rating table was created by the CCAT CBA analysis team and a version of this table was included in the CCAT CBA final report.

Task #	Likelihood Rank	Severity Rank	Likelihood * Severity	Overall Rank
1.1.1	20	80	4.55	15
1.1.2	55	80	3.25	44
1.1.3	109	49	1.40	108
1.1.4	178	41	0.00	178
1.2.1	92	18	2.40	69
1.2.2	92	18	2.40	69
1.2.3	109	16	1.70	95
1.2.4	109	18	1.60	96
1.2.5	109	18	1.60	96
1.2.6	109	49	1.40	108
1.2.7	109	49	1.40	108
1.2.8	140	41	0.75	148
1.2.9	178	1	0.00	178
1.3.1	20	143	2.80	58
1.3.2	38	87	3.60	37
1.3.3	77	175	0.80	138
1.3.4	109	143	0.80	138
1.4.1	109	18	1.60	96
1.4.2	109	41	1.50	101
1.4.3	140	5	0.95	134
1.4.4	178	1	0.00	178
2.1.1	20	158	2.45	68
2.1.2	20	172	1.75	94
2.1.3	55	172	1.25	118
2.1.4	92	18	2.40	69
2.1.5	109	143	0.80	138
2.1.6	109	160	0.60	157
2.1.7	140	7	0.90	135
2.1.8	140	7	0.90	135
2.1.9	140	18	0.80	138
2.1.10	140	18	0.80	138
2.1.11	140	49	0.70	150
2.1.12	140	49	0.70	150
2.2.1	35	49	4.55	15
2.2.2	38	143	2.40	69
2.2.3	55	18	4.00	25
2.2.4	92	116	1.50	101
2.2.5	140	116	0.50	162
2.2.6	140	183	0.10	177
2.2.7	178	18	0.00	178
2.2.8	178	160	0.00	178
2.2.9	178	160	0.00	178
2.3.1	55	160	1.50	101
2.3.2	55	175	1.00	130
2.3.3	109	49	1.40	108
2.4.1	1	160	2.40	69
2.4.2	20	175	1.40	108
2.5.1	77	137	1.80	92
2.5.2	90	80	2.28	82
2.5.3	90	80	2.28	82
2.6.1	55	7	4.50	18
2.6.2	77	7	3.60	37
2.6.3	109	49	1.40	108
3.1.1	55	18	4.00	25
3.1.2	77	77	2.67	61
3.2.1	54	49	3.97	32
3.2.2	92	49	2.10	87
3.2.3	92	49	2.10	87
3.2.4	92	49	2.10	87
3.2.5	92	141	1.30	117
3.2.6	109	87	1.20	119
3.2.7	140	45	0.73	149
3.2.8	140	49	0.70	150
3.2.9	140	49	0.70	150
3.2.10	140	49	0.70	150
4.1.1	17	1	7.67	1
4.1.2	38	49	4.20	22
4.1.3	92	18	2.40	69
4.2.1	55	116	2.50	63
4.2.2	108	87	1.60	96
4.3.1	109	87	1.20	119
4.4.1	55	116	2.50	63
5.1.1	140	18	0.80	138
5.2.1	109	143	0.80	138
5.3.1	1	87	4.80	13
5.3.2	37	77	4.22	21
5.3.3	77	156	1.47	107
5.3.4	92	156	1.10	126
5.3.5	109	36	1.53	100
5.3.6	139	36	1.02	129
5.3.7	140	36	0.77	147
5.4.1	140	175	0.20	172
5.4.2	140	175	0.20	172
5.5.1	55	36	3.83	33

Task #	Likelihood Rank	Severity Rank	Likelihood * Severity	Overall Rank
5.5.2	92	17	2.50	63
5.5.3	140	175	0.20	172
5.6.1	109	87	1.20	119
5.7.1	1	136	3.60	37
5.7.2	1	143	3.20	46
5.7.3	20	137	3.15	51
5.7.4	20	160	2.10	87
5.7.5	38	7	5.40	8
5.7.6	38	49	4.20	22
5.7.7	38	137	2.70	60
5.7.8	38	143	2.40	69
5.7.9	55	80	3.25	44
5.7.10	55	137	2.25	85
5.7.11	77	18	3.20	46
5.7.12	77	87	2.40	69
5.7.13	77	108	2.27	84
5.7.14	109	110	1.10	126
5.7.15	109	116	1.00	130
5.7.16	109	143	0.80	138
5.7.17	109	160	0.60	157
5.7.18	140	116	0.50	162
5.7.19	140	143	0.40	167
5.7.20	140	160	0.30	168
5.7.21	140	172	0.25	171
5.8.1	38	49	4.20	22
5.8.2	38	87	3.60	37
5.8.3	92	116	1.50	101
5.8.4	109	49	1.40	108
5.8.5	138	85	1.06	128
5.9.1	17	6	6.84	2
5.9.2	17	18	5.87	5
5.9.3	38	45	4.40	19
5.9.4	55	18	4.00	25

Task #	Likelihood Rank	Severity Rank	Likelihood * Severity	Overall Rank
5.9.5	77	87	2.40	69
5.9.6	140	18	0.80	138
5.10.1	1	18	6.40	3
5.10.2	20	41	5.25	11
5.10.3	20	49	4.90	12
5.10.4	55	87	3.00	54
5.10.5	76	49	3.15	51
5.10.6	92	116	1.50	101
5.10.7	109	116	1.00	130
5.10.8	140	7	0.90	135
5.10.9	140	116	0.50	162
5.11.1	20	116	3.50	43
5.11.2	20	143	2.80	58
5.11.3	92	116	1.50	101
5.12.1	92	45	2.20	86
6.1.1	1	49	5.60	6
6.1.2	1	87	4.80	13
6.1.3	1	116	4.00	25
6.1.4	1	116	4.00	25
6.1.5	1	116	4.00	25
6.1.6	1	160	2.40	69
6.1.7	20	7	6.30	4
6.1.8	38	7	5.40	8
6.1.9	55	87	3.00	54
6.1.10	55	116	2.50	63
6.1.11	77	87	2.40	69
6.1.12	109	7	1.80	92
6.1.13	109	49	1.40	108
6.1.14	140	1	1.00	130
6.1.15	140	49	0.70	150
6.1.16	140	87	0.60	157
6.1.17	140	116	0.50	162
6.1.18	140	160	0.30	168

Task #	Likelihood Rank	Severity Rank	Likelihood * Severity	Overall Rank
6.1.19	140	160	0.30	168
6.1.20	140	175	0.20	172
6.1.21	140	175	0.20	172
7.1.1	1	77	5.33	10
7.1.2	1	111	4.27	20
7.1.3	20	111	3.73	35
7.1.4	20	111	3.73	35
7.1.5	38	111	3.20	46
7.1.6	38	143	2.40	69
7.1.7	55	85	3.17	50
7.1.8	77	45	2.93	57
7.1.9	140	87	0.60	157
7.2.1	109	108	1.13	125
7.3.1	1	159	2.67	61
7.3.2	20	141	3.03	53
7.3.3	38	111	3.20	46
7.3.4	55	36	3.83	33
7.4.1	1	49	5.60	6
7.4.2	55	87	3.00	54
7.4.3	109	49	1.40	108
7.4.4	140	49	0.70	150
7.4.5	140	87	0.60	157
7.4.6	140	116	0.50	162
8.1.1	1	116	4.00	25
8.1.2	77	160	1.20	119
8.1.3	92	143	1.20	119
8.2.1	35	49	4.55	15
8.2.2	38	87	3.60	37
8.2.3	38	87	3.60	37
8.2.4	55	116	2.50	63
8.2.5	55	143	2.00	91
8.2.6	77	87	2.40	69
8.2.7	109	87	1.20	119

APPENDIX T. RISK MATRIX

The CCAT CBA analysis team created the Risk Matrix and was included in the CCAT CBA final report.

Severity \ Likelihood	0.00	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
10.00	1.2.9, 1.4.4	6.1.14													4.1.1					
9.50		1.4.3													5.9.1					
9.00		2.1.7, 2.1.8, 5.10.8		6.1.12				2.6.2		2.6.1		5.7.5, 6.1.8		6.1.7						
8.50				1.2.3																
8.00	2.2.7	2.1.9, 2.1.10, 5.1.1, 5.9.6, 6.1.15		1.2.4, 1.2.5, 1.4.1		1.2.1, 1.2.2, 2.1.4, 4.1.3	7.3.1	5.7.11		2.2.3, 3.1.1, 5.9.4					5.9.2	5.10.1				
7.50	1.1.4	1.2.8, 5.3.6, 5.3.7		1.4.2, 5.3.5		5.12.1		7.1.8		7.3.4		5.9.3		5.10.2						
7.00		2.1.11, 2.1.12, 3.2.7, 3.2.8, 3.2.9, 3.2.10, 7.4.4		1.1.3, 1.2.6, 1.2.7, 2.3.3, 2.6.3, 5.8.4, 6.1.13, 7.4.3		3.2.2, 3.2.3. 3.2.4			5.10.5	3.2.1, 5.5.1		4.1.2, 5.7.6, 5.8.1	2.2.1, 8.2.1	5.10.3		6.1.1, 7.4.1				
6.50			5.8.5				2.5.2, 2.5.3	3.1.2		1.1.2, 5.7.9, 7.1.7		5.3.2		1.1.1		7.1.1				
6.00		6.1.16, 7.1.9, 7.4.5		3.2.6, 4.3.1, 5.6.1, 8.2.7	4.2.2			5.7.12, 5.9.5, 6.1.11, 8.2.6		5.10.4, 6.1.9, 7.4.2		1.3.2, 5.8.2, 8.2.2, 8.2.3				5.3.1, 6.1.2				
5.50				5.7.14, 7.2.1				5.7.13				7.1.5, 7.3.3		7.1.3, 7.1.4		7.1.2				
5.00		2.2.5, 5.10.9, 5.7.18, 6.1.17, 7.4.6		5.10.7, 5.7.15		2.2.4, 5.10.6, 5.11.3, 5.8.3				4.2.1, 4.4.1, 6.1.10, 8.2.4				5.11.1		6.1.3, 6.1.4, 6.1.5, 8.1.1				
4.50								2.5.1		5.7.10		5.7.7		5.7.3, 7.3.2		5.7.1				
4.00		5.7.19		1.3.4, 2.1.5, 5.2.1, 5.7.16		3.2.5, 8.1.3				8.2.5		2.2.2, 5.7.8, 7.1.6		1.3.1, 5.11.2		5.7.2				
3.50						5.3.4		5.3.3						2.1.1						
3.00	2.2.8, 2.2.9	5.7.20, 6.1.18, 6.1.19		2.1.6, 5.7.17				8.1.2		2.3.1				5.7.4		2.4.1, 5.5.2, 6.1.6				
2.50		5.7.21								2.1.3				2.1.2						
2.00		5.4.1, 5.4.2, 5.5.3, 6.1.20, 6.1.21						1.3.3		2.3.2				2.4.2						
1.50																				
1.00		2.2.6																		
0.50																				
0.00																				

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APPENDIX U. PRIORITIZED TASK-LEVEL RECOMMENDATIONS

The prioritized task-level recommendations were created by the CCAT CBA analysis team. These recommendations were included in the CCAT CBA final report.

Priority	Task #	Overall Rank	Manpower (15)
1	5.10.1	3	Determine how many people and what kinds of jobs are needed
2	6.1.7	4	Actually fill the billet/job in order to be a part of the acquisition process.
3	6.1.1	6	Actually fill the billet/job in order to be a part of the acquisition process.
4	7.4.1	6	Actually fill the billet/job in order to be a part of the acquisition process.
5	7.1.1	10	Define manning requirements / manning policy for international operations
6	5.10.3	12	Instructor numbers need to be identified to ensure proper support for training
7	5.3.1	13	Task analysis would provide knowledge of current manpower…not necessarily what is on the UMD
8	2.2.1	15	Determine manning requirements for translators (how many translator per mission)
9	8.2.1	15	CONOPS that identifies needed manpower during situations would support necessary manpower requirements during surge operations
10	5.8.2	22	Manpower study would show if evaluations can be supported by current model or if additional support is needed
11	6.1.14	134	Understanding the manpower burden when conducting a recall would ensure proper support.
12	1.4.3	135	Knowing the proper manpower mix to ensure care is provided efficiently and safely
13	2.1.7	135	Knowing the proper manpower mix to ensure care is provided efficiently and safely
14	1.1.4	178	Manpower allows team and equipment to be transported. Knowing the proper amount of manpower is essential to getting the mission accomplished.
15	1.2.9	178	Knowing the amount of available manpower will enable the proper selection of personnel for missions

Priority	Task #	Overall Rank	Personnel (21)
1	4.1.1	1	Personnel Selection and Retention: Selecting Reservist who have critical care jobs and assignments
2	5.9.2	2	Personnel Selection process tailored to a CCAT physician and improve retention methods
3	5.10.1	3	Identify who these people are and select them
4	6.1.7	4	Select people with CCAT expertise (SME with both tactical and operational level experience)
5	5.9.3	5	Personnel Selection process tailored to a CCAT RT and improve retention methods
6	6.1.1	6	Select people with CCAT expertise (SME with both tactical and operational level experience)
7	7.4.1	6	Select people with CCAT expertise (SME with both tactical and operational level experience)
8	5.10.3	12	Personnel identifiers need to be obtained in order to ensure proper experience and qualification
9	5.3.1	13	Task analysis would provide the knowledge of what skills are needed to accomplish current mission and missions of the future
10	2.2.1	15	Personnel with language skills need to be available to assist when needed
11	8.2.1	15	CONOPS that identifies needed personnel skills during situations would support necessary skills during surge or contingency operations
12	5.9.4	19	Personnel Selection process tailored to a CCAT Nurse and improve retention methods
13	4.1.2	22	Personnel with the skills to use equipment need to be identified as instructors
14	5.7.7	22	Personnel with the skills to teach fatigue management need to be identified as instructors
15	5.8.2	22	Individuals with the credentials to evaluate need to be identified
16	5.9.5	25	Keeping track of personnel skills throughout career and not just while in a CCAT UTC will enable a broader pool of potential candidates for CCAT
17	6.1.14	134	Having personnel that have the proper skills to conduct the recall as well as the proper personnel identified to accomplish mission is needed.
18	1.4.3	135	CCAT personnel need to have the skills to care for pediatric patients

Priority	Task #	Overall Rank	Personnel (21)
19	2.1.7	135	CCAT personnel need to have the skills to care for neonatal patients
20	1.1.4	178	Personnel with the appropriated skills to handle equipment and ensure items are transferred in a timely manner is essential to the mission.
21	1.2.9	178	Knowing the skill set of each available member will enable proper selection of personnel for missions

Priority	Task #	Overall Rank	Training (32)
1	4.1.1	1	Training in Place, refresher training at specified intervals so they maintain it
2	5.9.2	2	Provide Training for those selectees who are not as "suitable" or barely meet the selection criteria
3	5.10.1	3	Evaluate training to determine if there are better ways of delivering training or more efficient way of training
4	6.1.7	4	Need to be trained on the HSI acquisition process
5	5.9.3	5	Provide Training for those selectees who are not as "suitable" or barely meet the selection criteria
6	6.1.1	6	Need to be trained on the HSI acquisition process
7	7.4.1	6	Need to be trained on the HSI acquisition process
8	5.7.6	8	Using the information from HFE Study, formulate a curriculum
9	6.1.8	8	Procured equipment must have training
10	7.1.1	10	Training would have to be expanded to include implications for international operations
11	5.10.2	11	Provide high fidelity simulator or computer-based training that represents same equipment used during CCAT operation.
12	5.10.3	12	If there is a shortage of experienced and qualified instructors training needs to be implemented to improve instructor skills
13	5.3.1	13	Task analysis would provide the knowledge of what training is needed to ensure proper skills for missions of today and the future
14	2.2.1	15	Secondary language training could be available when known operations are occurring in non-English speaking areas
15	2.6.1	18	Training on how to on-off load patients from platforms not currently used would alleviate patient safety and personnel safety concerns as well as mission delay
16	5.9.4	19	Provide Training for those selectees who are not as "suitable" or barely meet the selection criteria
17	4.1.2	22	Training needs to be accomplished to teach students on how to use unfamiliar equipment
18	5.7.7	22	Training needs to be accomplished to teach students on how to manage fatigue

Priority	Task #	Overall Rank	Training (32)
19	5.8.2	22	Evaluation tools need to be developed and taught to evaluators
20	3.1.1	25	Training the importance of resilience as well as ways to improve resilience with improve Human Performance but also system performance and patient care
21	6.1.4	25	Personnel will need to be trained on how to utilize technology and how to work without technology if there is a system downtime or failure
22	6.1.5	25	Personnel will need to be trained on how to utilize technology and how to work without technology if there is a system downtime or failure
23	8.1.1	25	Teach CCAT personnel how to access and use database
24	2.6.2	37	Training on how to on-off load patients from platforms currently used would alleviate patient safety and personnel safety concerns as well as mission delay
25	2.5.1	92	Personnel need to understand and recognize notifications provided by the equipment.
26	2.1.2	95	Personnel need to know what equipment to collect
27	5.10.7	130	Training is necessary to ensure oxygen is provided correctly
28	6.1.14	134	Training would allow personnel to know how to contact the needed CCAT members.
29	1.4.3	135	Training needs to be provided that allows CCAT members to understand and feel comfortable treating pediatric patients
30	2.1.7	135	Training needs to be provided that allows CCAT members to understand and feel comfortable treating neonatal patients
31	2.1.8	135	Training needs to replicate real world operations.
32	1.1.4	178	Personnel need to be trained on how to transport equipment and drive on the flight line.

Priority	Task #	Overall Rank	HFE (18)
1	5.7.6	8	Gap in Knowledge bridged by conducting an HFE Study
2	6.1.8	8	Designed to usable for CCAT personnel
3	7.1.1	10	Provide equipment that can be read by allied partner (language, units, symbology)
4	5.3.1	13	Task analysis would identify where inefficiencies exist
5	6.1.2	13	Equipment needs to be designed to allow storing of perishable items
6	1.1.1	15	Address usability issues with recall roster (ease of updating, accessibility, standardization, etc.)
7	2.6.1	18	Equipment that allows personnel to easily on/off load patients into any platform could alleviate risks (account for ergonomic considerations for non-standard platform)
8	7.1.2	20	Equipment needs to be analyzed to determine what areas can be standardized and what limitations exist between DoD and ISO users
9	6.1.3	25	Equipment should be developed that allows for patient monitoring from locations other than immediate proximity. HFE can focus on how to best utilize technologies to optimize human and equipment performance.
10	6.1.4	25	HFE can help create an easy to use technology while also accomplishing what is needed for the mission
11	6.1.5	25	HFE can help create an easy to use technology while also accomplishing what is needed for the mission
12	8.1.1	25	Address usability issues with (ease of updating, accessibility, standardization, etc.). Ensure platform database address ergonomic considerations of platform information
13	2.6.2	37	Equipment that allows personnel to easily on/off load patients into any platform could alleviate risks (account for ergonomic considerations for standard platform)
14	2.5.1	92	Equipment needs to be designed to operate and be effective in every situation.
15	2.1.2	95	Equipment should be easily accessible and in working condition
16	5.10.7	130	Equipment needs to be designed to allow personnel to quickly and correctly provide 02
17	2.1.8	135	Equipment should be designed to optimize human performance and ease understanding
18	1.1.4	178	Organizing and designing transportation that accommodates all personnel and equipment is needed.

Priority	Task #	Overall Rank	Safety (16)
1	5.7.6	8	Safety Domain Experts can help with the HFE Study
2	7.1.1	10	Establish international safety regulations regarding medical care (operating limitations, overall authority, cultural differences in standards for medical practices)
3	5.3.1	13	Task analysis would identify where high risk tasks and determine ways to mitigate those risks
4	2.6.1	18	Patient and personnel safety is at risk when utilizing unfamiliar platforms. An analysis of safety concerns (lifting, bending, twisting, etc.) could provide guidance of how to bridge this future gap.
5	7.1.2	20	Patient safety needs to be incorporated and analyzed when creating standards for equipment outside of the US and DoD
6	5.7.7	22	Safety risks can be used to support the need for fatigue management education
7	8.1.1	25	Database should include CCAT personnel and patient safety considerations for platforms (ex: how to enter helo rotor arc, PE required, safety belts, egress points, etc.)
8	2.6.2	37	Patient and personnel safety is at risk when utilizing platforms due to familiarity. An analysis of safety concerns (lifting, bending, twisting, etc.) could provide guidance of how to bridge this gap.
9	2.5.1	92	Understanding the environment and how humans react/notice signals will improve patient safety.
10	2.1.2	95	Understanding ramifications of not collecting correct equipment could prevent patient safety issues.
11	5.10.7	130	Equipment needs to provide 02 correctly to ensure patient safety
12	1.4.3	135	Understanding how to treat pediatric patients improves patient safety
13	2.1.7	135	Understanding how to treat neonatal patients improves patient safety
14	2.1.8	135	Proper use and familiarity with equipment ensures patient safety.
15	1.1.4	178	Safety is essential when traveling on the airfield. Knowing the risks and how to use equipment leads to a safe transport.
16	1.2.9	178	Selecting the proper mix of CCAT personnel improves patient safety

Priority	Task #	Overall Rank	OH (7)
1	5.7.6	8	OH Domain Experts can help with HFE Study
2	5.3.1	13	Task analysis would identify health hazards and determine root cause (fatigue, injury, PTSD, etc.)
3	2.6.1	18	Use of unfamiliar platforms provides an OH risk. Analysis of potential interactions with unknown platforms could provide guidance on future needs.
4	5.7.7	22	OH studies can support the need for fatigue management education
5	3.1.1	25	Focusing on the aspects of the job that affect resilience can help reshape the mission and system to optimize human performance.
6	8.1.1	25	Database should include CCAT personnel and patient OH considerations for platforms (ex: vibration levels, noise, etc.)
7	2.6.2	37	Use of platforms provides an OH risk. Analysis of potential interactions with current platforms could provide guidance on needs.

Priority	Task #	Overall Rank	Environment (9)
1	5.3.1	13	Task analysis could identify what added work is being conducted to combat environmental constraints
2	5.7.7	22	Understanding the different operating environments could add diversity to curriculum
3	6.1.4	25	The operating environment needs to be examined when looking at electronic solutions
4	6.1.5	25	The operating environment needs to be examined when looking at electronic solutions
5	8.1.1	25	Database should include environmental considerations for platforms (ex: typical operating conditions)
6	2.5.1	92	The environment affects vision, hearing, etc. An understanding of differing environments will allow for better understanding of what equipment needs to be effective when signaling status changes.
7	5.10.7	130	Designers need to understand the environments that patients are using 02 in order to provide appropriate and correct 02 amounts.
8	2.1.8	135	The environment needs to be understood to ensure equipment is being provided and used in the same ways in training and in the field
9	1.2.9	178	Understand environmental demands that may alter mission requirements (manpower, specific skill set, additional AE personnel, etc)

Priority	Task #	Overall Rank	Habitability (4)
1	5.7.6	8	Habitability on patient and performance effects on CCAT personnel
2	7.1.1	10	Identify different habitability standards with respect to allied partner's culture
3	5.3.1	13	Task analysis could identify what added work is being conducted to combat habitability constraints
4	8.1.1	25	Database should include CCAT personnel and patient habitability considerations for platforms (ex: bathroom facilities, space, lighting, etc.)

Priority	Task #	Overall Rank	Survivability (3)
1	5.7.6	8	Patient survivability
2	3.1.1	25	Focus on personnel survivability will shift the focus from only getting the mission done to how the mission is affecting the personnel.
3	8.1.1	25	Database should include CCAT personnel and patient survivability considerations for platforms (ex: armor wings, crash worthiness, etc.)

Priority	Task #	Overall Rank	Doctrine (6)
1	4.1.1	1	Potential for joint training program
2	7.1.1	10	International Doctrine that address the cultural differences
3	8.2.1	15	Strategic level doctrine supporting CCAT operations would provide guidance for an A-typical operation
4	7.1.2	20	International Doctrine that address the cultural differences
5	5.3.2	21	Incorporate CCAT medical practices in CPGs
6	8.1.1	25	Joint Doctrine requires database for platform information

Priority	Task #	Overall Rank	Org (11)
1	4.1.1	1	Composition of CCAT teams could be adjusted so that CCAT teams pull more readily from those that have the proficiency
2	5.10.1	3	Determine how many people and what kinds of jobs are needed
3	6.1.7	4	Structure acquisition organization to include CCAT membership
4	6.1.1	6	Structure acquisition organization to include CCAT membership
5	7.4.1	6	Structure acquisition organization to include CCAT membership
6	7.1.1	10	International Organizational Structure
7	5.10.3	12	Organization needs to maintain knowledge of where experienced and qualified members are located
8	5.3.1	13	Task analysis could identify inefficiencies in the system
9	8.2.1	15	Dedicated CCAT representation at strategic level of organization
10	7.1.2	20	Organizational considerations need to be considered when establishing standards.
11	2.2.3	25	Provide a system that allows information to flow from the top to the bottom and back easily

Priority	Task #	Overall Rank	Materiel (15)
1	5.7.6	8	Develop a Crew Compartment in the aircraft that is pressurized at lower altitude
2	6.1.8	8	Procure equipment to monitor patient status
3	5.10.2	11	Equipment needs to be purchased and disseminated to units that is consistent AF wide
4	5.3.1	13	Task analysis could provide inefficiencies that materiel could overcome or where inefficiencies exist because of materiel
5	6.1.2	13	Equipment needs to be designed/purchased to allow storage of perishable items
6	1.1.1	15	Software to manage recall roster database (security, accessibility, standardization, readability)
7	2.6.1	18	Equipment that allows personnel to easily on/off load patients into any platform could alleviate risks
8	7.1.2	20	Equipment standards need to be vetted through all users to determine needs and ownership
9	6.1.3	25	Equipment procurement or development for remote monitoring could improve patient care
10	8.1.1	25	Software to manage recall roster database (security, accessibility, standardization, readability)
11	2.6.2	37	Equipment that allows personnel to easily on/off load patients into any platform could alleviate risks
12	2.5.1	92	Materiel needs to be acquired that does more than simply provide an auditory alarm
13	5.10.7	130	Equipment needs to provide 02 correctly and efficiently
14	2.1.8	135	Equipment needs to be consistent between the field and training
15	1.1.4	178	Transport equipment could be created to easily and efficiently transport personnel and equipment.

Priority	Task #	Overall Rank	Leadership and Education (8)
1	7.1.1	10	Educate AE and CCAT leaders on international policy
2	5.10.3	12	Educate CCAT leaders on the shortfalls related to instructor qualification
3	1.1.1	15	Leadership needs to understand importance of recall information and conduct updates on a regular basis
4	2.6.1	18	Education on A-typical platforms could inform personnel on future requirements
5	5.8.2	22	Leadership needs to have a means to evaluate instructors in a format other than the OPR/EPR
6	2.2.3	25	Teach leadership the importance of communication at all levels
7	8.1.1	25	Leadership must be educated on the benefits of database to ensure tactical and operational levels are generating it, updating it, and using it
8	2.6.2	37	Education on platforms could inform personnel on current requirements

Priority	Task #	Overall Rank	Facility (2)
1	7.1.2	20	Facilities need to be identified for testing and storage of equipment.
2	2.1.8	135	Facilities need to replicate what is occurring in the field

Priority	Task #	Overall Rank	Policy (28)
1	4.1.1	1	Mandated proficiency and currency policies
2	5.9.2	2	Update policy guidance on selection criteria, selection process, and eligibility requirements
3	5.10.1	3	Update policy to identify how many people and what kinds of jobs are needed
4	6.1.7	4	Policy requires CCAT representation
5	5.9.3	5	Update policy guidance on selection criteria, selection process, and eligibility requirements
6	6.1.1	6	Policy requires CCAT representation
7	7.4.1	6	Policy requires CCAT representation
8	7.1.1	10	International Policy that addresses cultural differences and how it will be conducted
9	5.10.2	11	Policy needs to be created that will ensure standardization of equipment
10	1.1.1	15	Policy needs to be implemented to ensure updated recall rosters are available in case of computer outages
11	2.2.1	15	Policy that allows bilingual personnel to travel as a part of CCAT during contingency situations could overcome this gap
12	2.6.1	18	Policy could be created to allow for access to A-typical platforms
13	5.9.4	19	Update policy guidance on selection criteria, selection process, and eligibility requirements
14	7.1.2	20	Policy will provide guidance on who owns what steps on the requirement development and procurement of equipment.
15	5.3.2	21	Policy will provide guidance on how and who best practices can be obtained from
16	4.1.2	22	Policy will provide guidance on how to implement training of unfamiliar equipment
17	5.7.7	22	Policy will provide guidance on how to implement training of fatigue management
18	5.8.2	22	Policy will provide guidance on how to implement evaluation programs
19	5.9.5	25	Policy will change the way personnel are monitored throughout their career and not just while at a specific location
20	6.1.4	25	Policy can be changed to support the use of electronic devices in aircraft
21	6.1.5	25	Policy can be changed to support the use of electronic devices in aircraft
22	8.1.1	25	Policy that provides guidance on the database (updates, accessibility, security standards)

Priority	Task #	Overall Rank	Policy (28)
23	2.2.3	25	Policy will provide guidance on ways communication should be enacted
24	2.5.1	92	Policy for equipment acquisition would ensure proper signaling when in adverse environments.
25	1.4.3	135	Policy needs to be created to allow care givers the ability to receive training and proficiency in local hospitals if MTF does not provide the appropriate patient population to maintain/improve skills
26	2.1.7	135	Policy needs to be created to allow care givers the ability to receive training and proficiency in local hospitals if MTF does not provide the appropriate patient population to maintain/improve skills
27	2.1.8	135	Policy would allow and ensure equipment that personnel are training on is the same as what they will see in the field
28	1.2.9	178	Policy could create a database of all personnel who have ever been CCAT and then determine what the best mix of personnel is for missions.

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